SEPTEMBER 11, 1937

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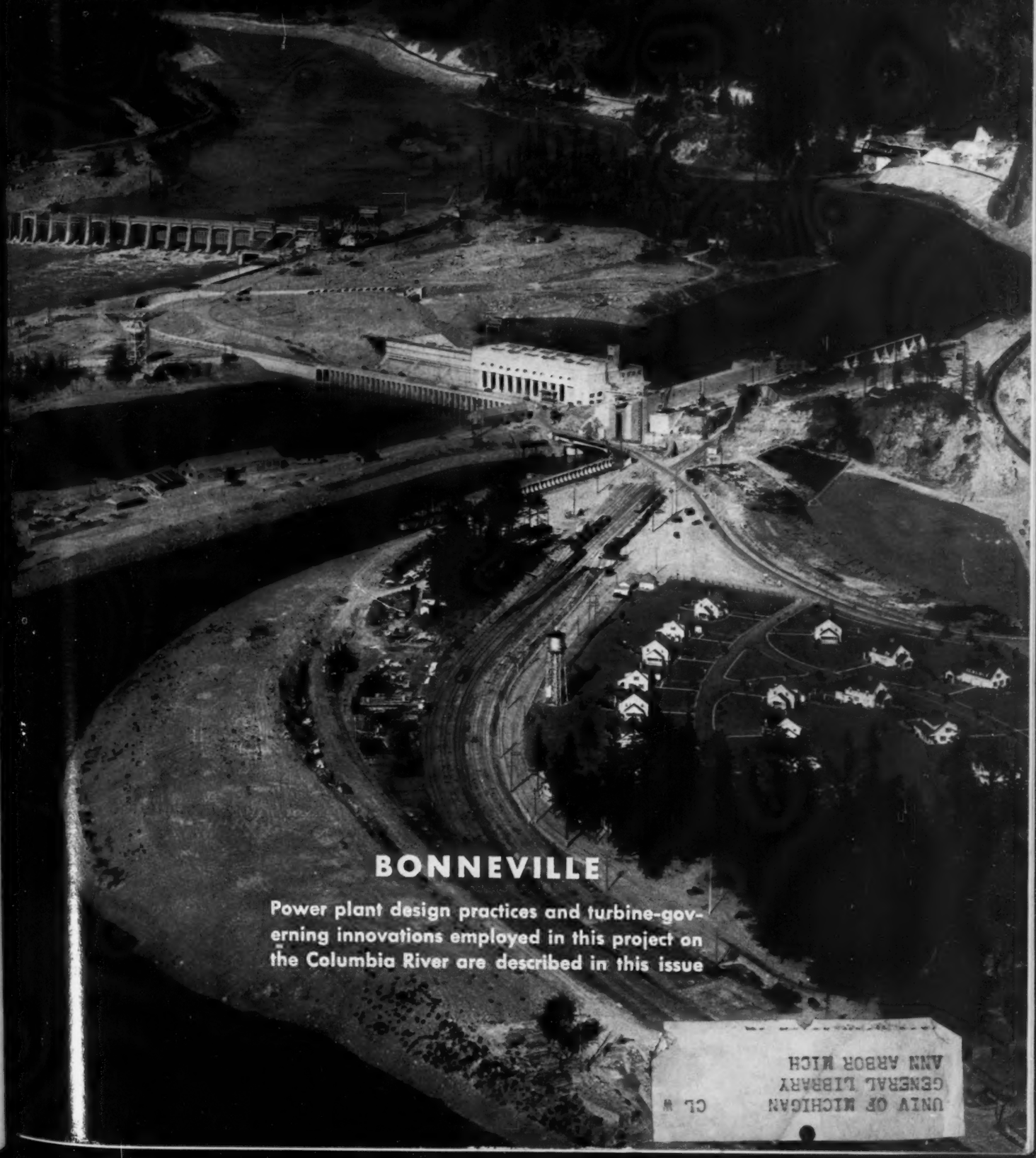

BONNEVILLE

Power plant design practices and turbine-governing innovations employed in this project on the Columbia River are described in this issue

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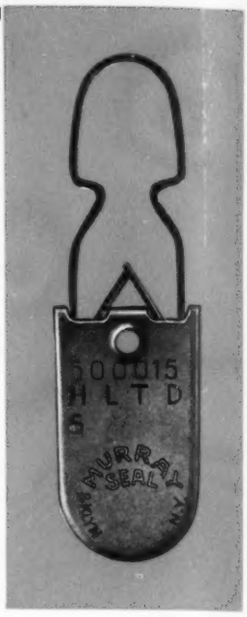

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Coming Features

Steam Station Cost Survey

ELECTRICAL WORLD will bring up to date its Steam Station Cost Survey of 1935 with the publication on October 9 of the latest information on enlarged plans and the addition of cost data on stations newly in operation.

Twin Branch Station Addition

A presentation by Philip Sporn of the engineering reasoning that led to the selection of the 2,500-lb., 940-deg. F., 62,500-kw. combination compounded turbine unit being added to the American Gas & Electric Company's Twin Branch station at Mishawaka, Ind., will be in an early issue.

Modernizing Waterside Station

Rehabilitation looking toward increased output from New York's Waterside station serving midtown Manhattan led to the installation of topping turbines, modern boilers, bus segregation and sectionalization leading to flexibility, superior protection and reliability. An article by Howard Braley describing the station's features will appear September 25.

On the Cover

This week's cover picture is an air view of the Bonneville Dam site looking east.

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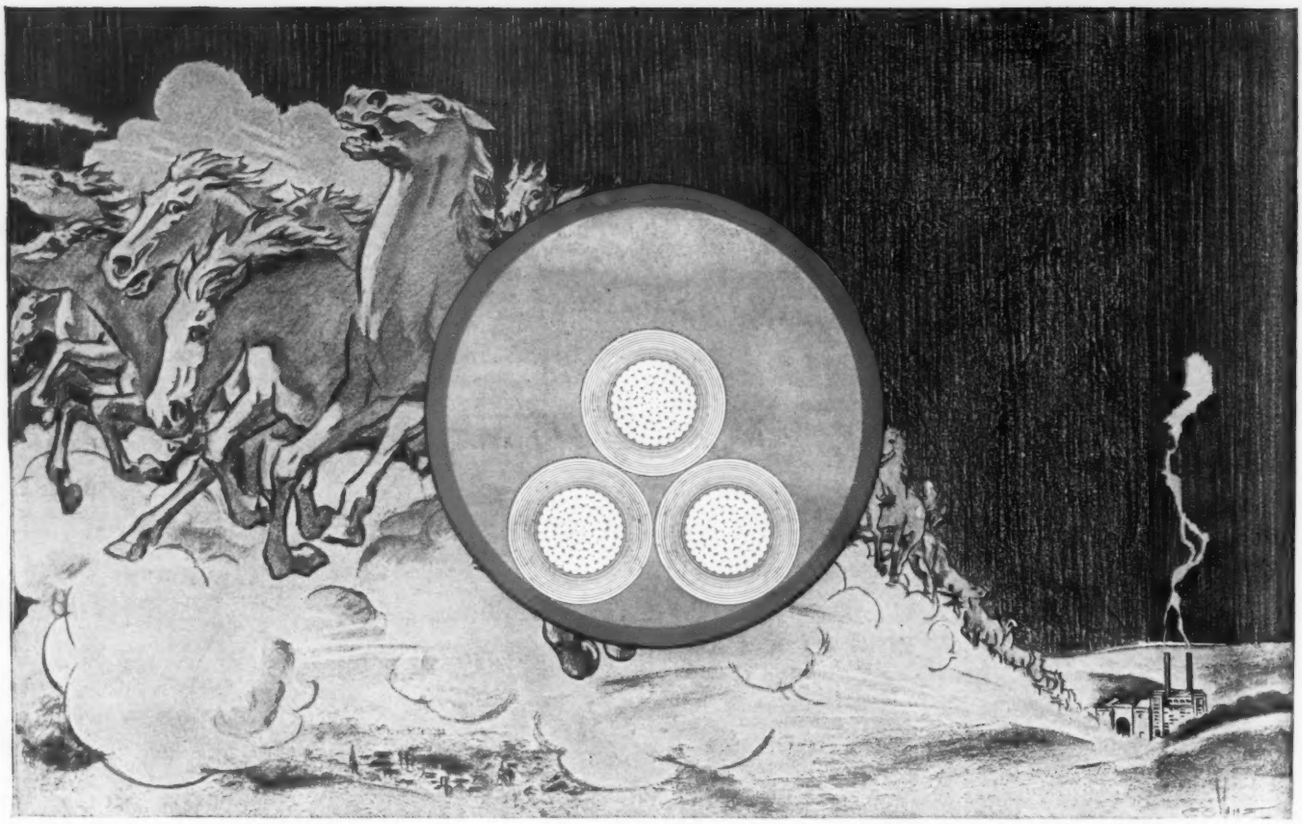

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ELECTRICAL WORLD

SEPTEMBER 11, 1937

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And No Place to Go

Bonneville, the big mystery federal project on the Columbia River that was designed for problematical loading, has been a series of problems for its designers, but will be a bigger problem for its owners. Writing in this issue, L. E. Kurtichanof, consulting engineer on the project, states that the nature of the service of Bonneville "from the beginning constituted a major difficulty in design. The location, size and nature of the prospective load was then entirely unknown. It is no better known today."

The big unfinished business at Bonneville, he states, is economic—what loads—what rates —how administered?

Therein lies the crux of the entire federal program of water-power development. Practically all of the sites that the government is developing were surveyed long ago by our private utilities and found wanting economically.

The prospect of cheap power, and the government will do everything it can to make the price low until the taxpayers catch up with it, will not lure industry into territories that are not naturally good industrial areas. It takes more than cheap power to make manufacturing a profitable venture. There are also such things as transportation of raw materials and finished products, markets, labor. And even if mere cheapness of power were an irresistible magnet, would the other communities of the country, from which must come the taxes to pay for these projects, permit the government to rob them of the industry that makes it possible for them to collect these taxes?

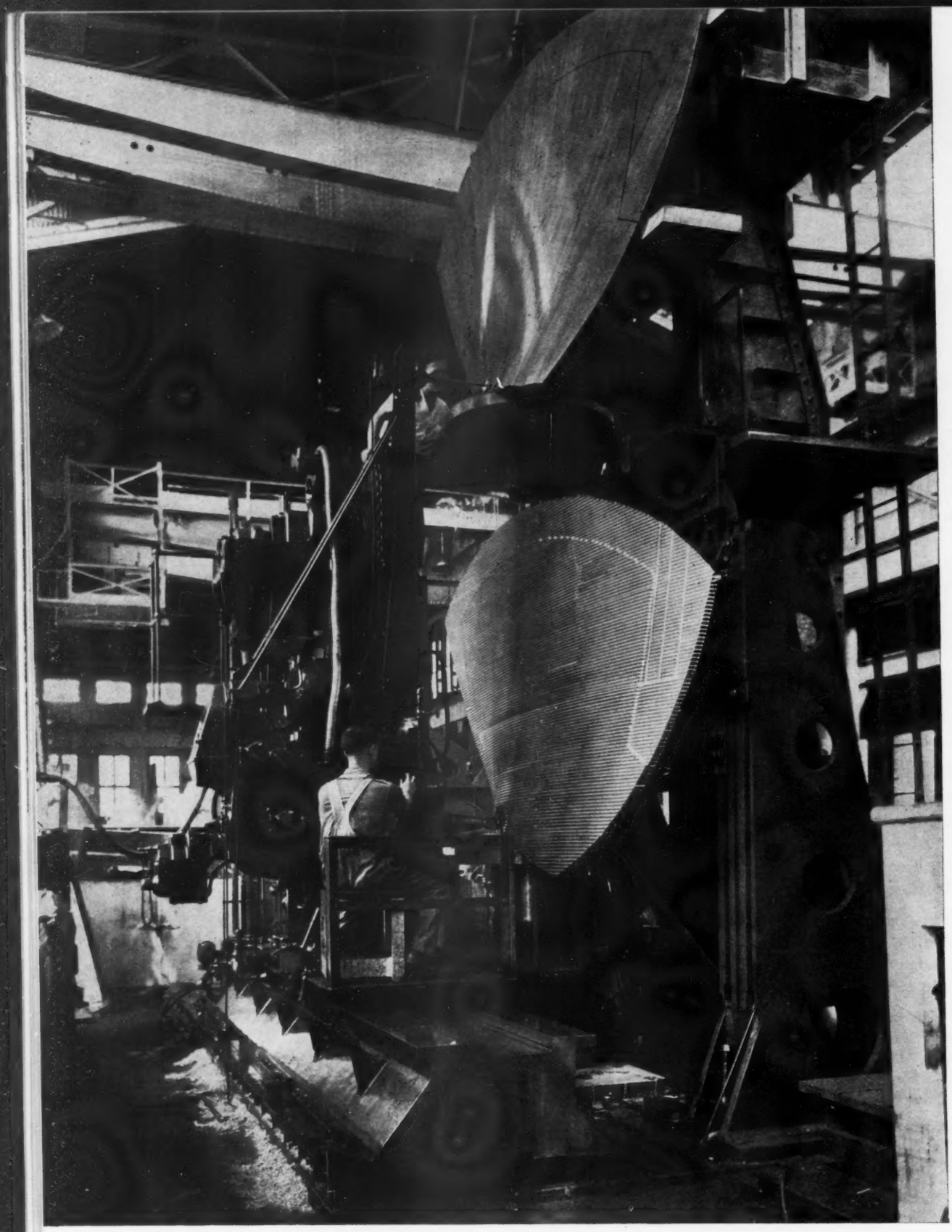
On frequent occasions the same government which blithely goes ahead building huge power projects with no visible market has severely criticised public utilities for overexpanding capacity. The administration tacked a tax on undivided surplus on industry as a part of its program to limit wide expansion of industry. Yet here it is doing the same thing for which it cracks down on industry.

Nevertheless the problem is before us. Here we have huge concentrations of power with no place to go. So long as they are idle they will be a menace to private capital. Something must be done about it. We cannot sit back and say that the government got itself into this mess and therefore that it must stew in its own juices. No matter how bitter the pill may be, it must be swallowed, or else greater trouble may be in store for us.

It isn't easy to co-operate with the present federal bodies, but there must be a way in which it can be accomplished without jeopardizing the rights of stockholders or tying a noose around one's neck.

The answer doesn't lie in the purchase of private systems by the government because there will still be just as much power available with no increase in market. It doesn't lie in competitive systems, because one of the greatest exponents of municipal ownership, J. D. Ross of Seattle and a member of the S.E.C., has proved that that course is not only wasteful but is not in the interests of the consumer. It can't be through the robbing of other sections of the country of their industries.

It can come through the co-operation of the government with the private utilities, wherein the latter as distributors of federal power under proper regulation can exercise their commercial ingenuity in the expansion of old and the development of new industries where none grew before. In this way federal projects can be made to add to the wealth of the nation instead of being a drain.



PUTS WARPED SURFACES ON KAPLAN BLADES

Huge Keller die-sinking machine at S. Morgan Smith plant in York, Pa., reproduces on Bonneville runner (below) the curvature of the master model above. Cavitation is thwarted by facing the point and edges with stainless steel where chalk marks show.

Petersen Coil Installed on 100-Kv. Colorado Line

Tuned Grounding Reactor Plus Counterpoise and Reinsulation Expected to Reduce Tripouts 75 per Cent — Oscillographs, Taken During Staged Faults, Promise Satisfactory Results

By W. D. HARDAWAY
Superintendent Hydro-Electric Production and Transmission
Public Service Company of Colorado, Denver

IN AN effort to improve service continuity on a badly exposed transmission line the Public Service Company of Colorado has placed in service one of the few American installations of the Petersen coil. As is generally known, this device is a neutral grounding reactor tuned so that the lagging current drawn by the coil substantially cancels out the line charging current, leaving only corona and leakage current to flow in accidental grounds. Arcs produced by this current readily extinguish themselves, thus clearing single-conductor arcing grounds without interrupting the circuit. Grounds involving more than one conductor are, of course, short circuits and cannot be cleared by the coil.

The Petersen coil, shown installed in Fig. 2, is equipped with ten tuning taps, available on a hand wheel brought down to a convenient level on the side of the case. These taps are also useful for retuning the coil when portions of the line are out for maintenance or other reasons. The coil is rated for ten-minute duty; that is, in the event of a conductor down or other continuous ground, ten minutes is available for disconnecting the faulty section of the line before the coil overheats. The weight of the assembled unit is 31,000 lb.

Tests were conducted for tuning the coil with the entire line in service and with the line sectionalized at various points. Also, staged arcing ground tests were made, with arcs started by small fuse wire over normal insulator strings. Additional test runs were made to determine the performance of Petersen coil arcs in expulsion gap tubes. An oscillogram taken of the normal string flashover is shown in Fig. 3 and one of an expulsion gap test in Fig. 4; Fig. 5 shows one of the staged flashovers. The bright spots showing on either side of the arc are particles of the fuse wire used to start the arc. The tests were conducted under the direction of Dr. W. W. Lewis of the General Electric Company, who has sponsored the development of the Petersen coil in this country.

A diagram showing the portion of the 100-kv. system to which the coil was applied is shown in Fig. 1. This line, from Shoshone hydro plant to Denver, crosses the Continental Divide

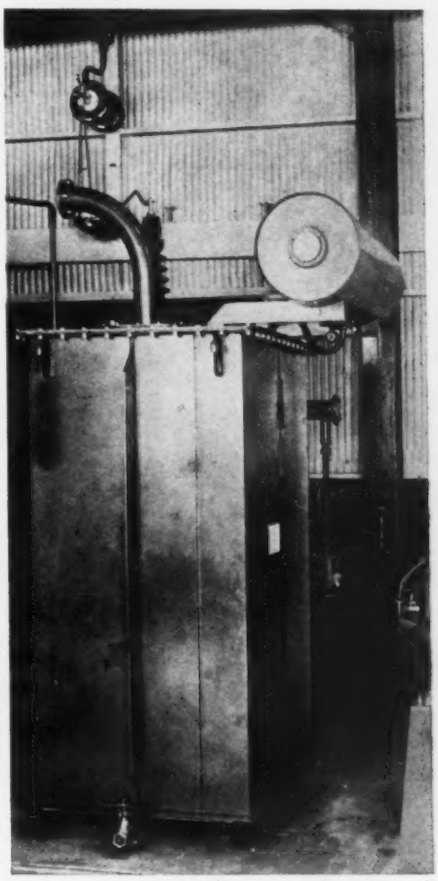


Fig. 2—Petersen coil installed in Shoshone hydro plant switchyard of Public Service Company of Colorado

The coil is equipped with ten taps for tuning.

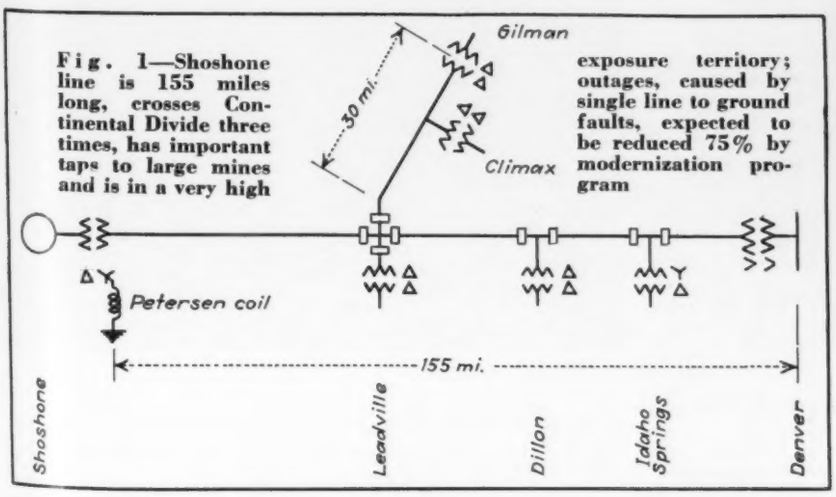


Fig. 1—Shoshone line is 155 miles long, crosses Continental Divide three times, has important taps to large mines and is in a very high exposure territory; outages, caused by single line to ground faults, expected to be reduced 75% by modernization program

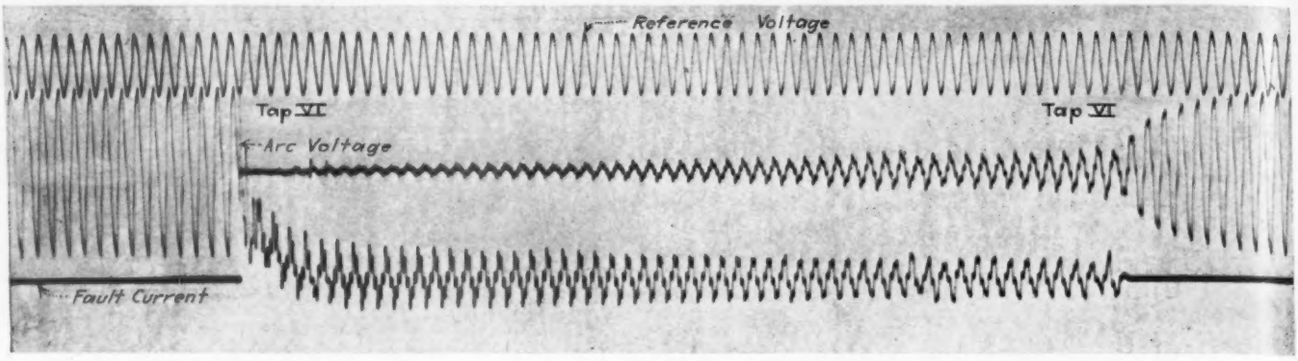


Fig. 3 — Oscillogram of a staged flashover of a normal insulator string, the Petersen coil being set on Tap No. 4

three times, and much of its length is at an elevation of 10,000 ft. or more above sea level. The conductor diameter is small and the line operates normally with an appreciable corona loss, which made this application particularly interesting, as the coil cannot compensate for corona current. The arc current at the tuned point, as measured during the tests, was 21 amp. However, the arc extinguished itself readily, usually within one second, although in one case, in still air and with the coil somewhat off tune, the arc held on for fourteen seconds before breaking.

The Shoshone line not only delivers power to Denver from the Shoshone hydro plant, but also serves very important mining loads, particularly in the Leadville area, and in the past service continuity has left much to be desired as lightning frequency is high and the line is badly exposed. The past record of the line has averaged some 76 tripouts per year. It is anticipated that the coil will immediately reduce outages by 50 per cent.

However, the line towers have rather high footing resistance, and until this condition is corrected a high percentage of lightning strokes may be expected to cause flashovers of more than one insulator string per tower. To give the Petersen coil more opportunity to function, a counterpoise connecting towers is being installed. Also, line insulation is being improved and sections of conductor are being replaced with material of larger diameter to reduce the corona current. When this work is completed a reduction of tripouts in the order of 75 per cent is anticipated. The performance of the coil during the tests was entirely satisfactory and its performance in service will be watched with great interest.

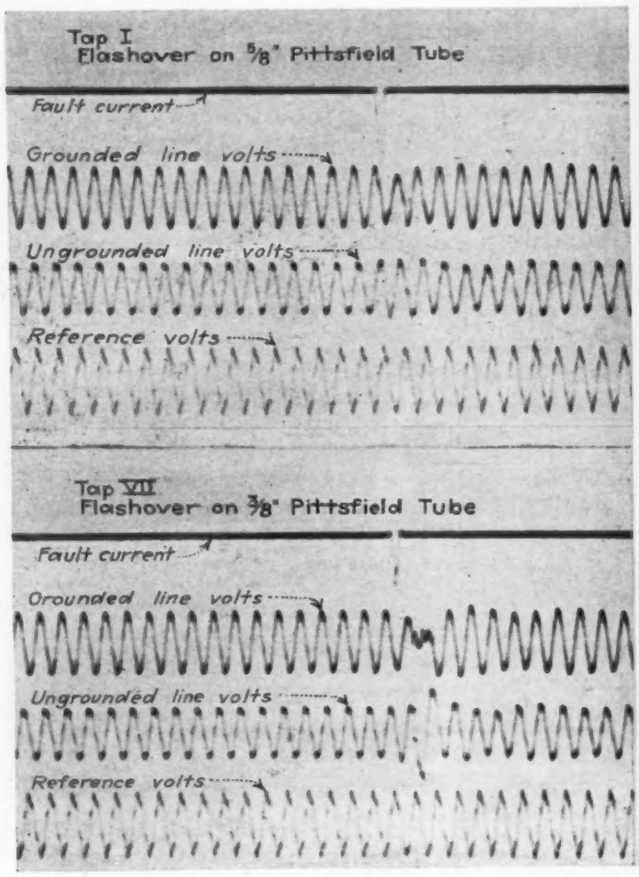


Fig. 4—Oscillograms of staged flashovers on two sizes of expulsion gaps. Note quick recovery of normal conditions

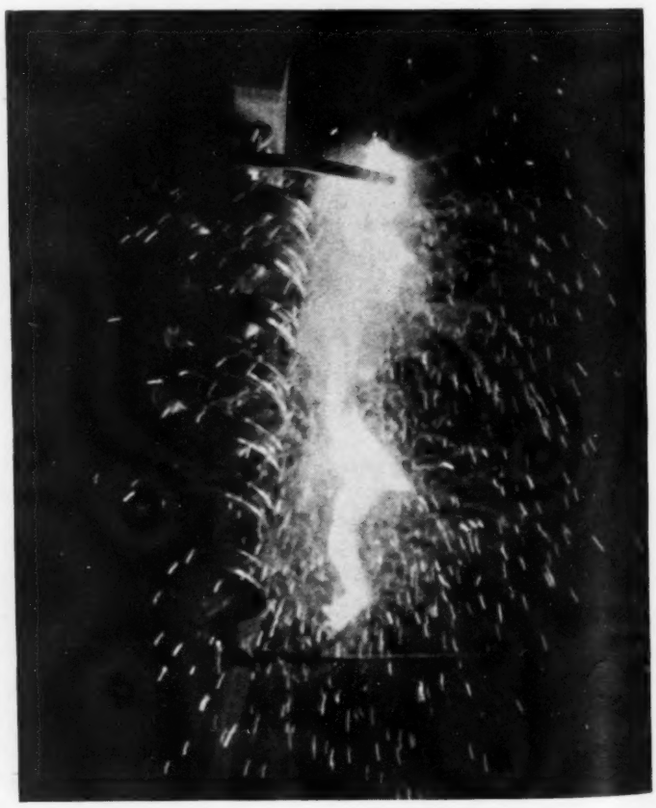


Fig. 5—Photographic view of a staged flashover. The ends of the fuse wire used to initiate the arc are visible at top and bottom of the string

Pasadena Analyzes Gains From Frequency Change

By M. W. EDWARDS
Junior Electrical Engineer,
Pasadena (Calif.), Municipal Light and Power Department

AVAILABILITY of Boulder Dam power at 60 cycles through the transmission facilities of the Los Angeles Bureau of Power and Light permitted the Pasadena, Calif., Municipal system to effect savings in investment and improve operating efficiency by changing to that frequency from the former 50-cycle service. The city has contracted for 68,000,000 kw.-hr. of firm power from Boulder Dam annually.

Borrowing from the research studies made by the city of Los Angeles, which had made exhaustive investigations in preparation for its changeover to 60 cycles, the Pasadena changeover was initiated by a survey inspecting and recording data of all equipment connected to the commercial and power meters of the system and making a survey of all commercial and domestic customers by mail asking them to list their electrical equipment. Some 70 per cent return was obtained on this survey, from which the tabulation of data of household equipment in the city was prepared as shown in Table I.

Successful completion of the actual changeover has permitted the calculation of interesting data on the savings obtained therefrom. The mechanical changeover was accomplished by cutting over one 2,400-volt feeder per week, each feeder serving about 1,500 customers. Critical commercial equipment was adjusted before or during the cutover and such adjustments as were necessary in domestic and miscellaneous equipment made a few days later. Generally speaking, commercial equipment was restored to its 50-cycle speed by pulley or gear changes. Small direct drives were reconnected or rewound for two more poles. Clocks and time switches were restored to normal speeds by gear or rotor changes and pump outputs by trimming impellors or removing a stage.

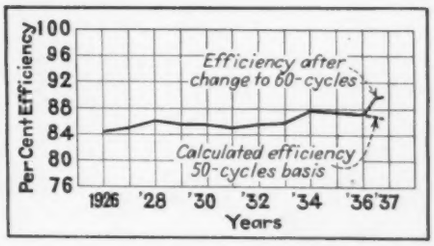
Domestic equipment, with the exception of clocks, was allowed to absorb the increased speed forced by the

[*Continued on page 130*]

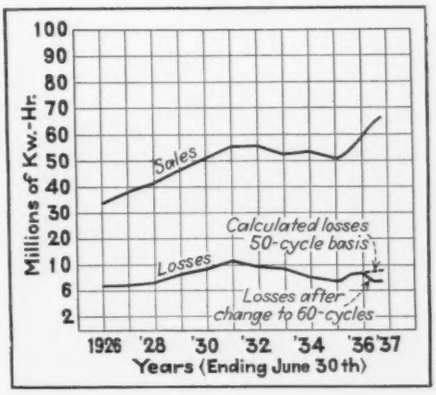
Table I—Approximate Quantities of Household Appliances in Use in Pasadena

As of January 1, 1937

Name	Number in City	Number Adjusted
Electric irons	23,800	.....
Radios	19,500	.....
Electric clocks	15,000	15,000
Vacuum cleaners	11,680	.....
Toasters	11,370	.....
Washing machines	11,150	3,380
Refrigerators	9,500	2,397
Coffee percolators	7,650	.....
Waffle irons	4,470	.....
Space heaters	4,000	.....
Sewing machines	3,840	.....
Heating pads	3,750	.....
Ironing machines	1,065	83
Electric ranges	604	.....
Grayson cooking clocks	525	525
Phonographs (electric)	292	292
Water heaters (electric)	199	.....
Dishwashers	130	65



Distribution system efficiency in Pasadena over a ten-year period which culminated in changing over from 50 to 60 cycles. Savings in core and copper losses account for the gain under 60-cycle operation.



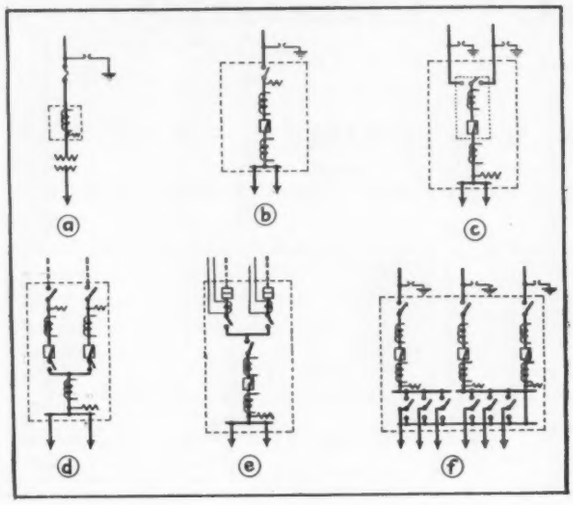
Energy sales and losses of the system show a wider spread as a result of the change-over

Table II—Pasadena Municipal Light and Power Department Tabulation of System Losses and Efficiency

	50 Cycle	Per Cent Increase of Load and Number of Customers	50 Cycle	60 Cycle	Per Cent Saving 60 Cycles Over 50 Cycles
	Six Months from Sept., 1935, to Feb., 1936, incl. Measured Data		Six Months from Sept., 1936, to Feb., 1937, incl. Calculated Data on 50-Cycle Basis	Six Months from Sept., 1936, to Feb., 1937, incl. Measured Data	
A. Core Loss					
47,390-kva. distribution transformers	1,142,000 kw.-hr.	1.3	1,157,000 kw.-hr.	969,000 kw.-hr.	16.4
28,500-kva. substation transformers	315,000 kw.-hr.	0.0	315,000 kw.-hr.	266,000 kw.-hr.	15.6
24 induction volt regulators	105,000 kw.-hr.	0.0	105,000 kw.-hr.	88,000 kw.-hr.	16.2
B. Meter shunt losses	270,000 kw.-hr.	0.8	272,000 kw.-hr.	242,000 kw.-hr.	11.0
C. Copper losses	2,637,000 kw.-hr.	26.5	3,335,000 kw.-hr.	2,473,000 kw.-hr.	25.8
D. Unaccounted for losses	173,000 kw.-hr.	13.2	196,000 kw.-hr.	196,000 kw.-hr.	0.0
(1) Total losses	4,645,000 kw.-hr.	16.0	5,380,000 kw.-hr.	4,234,000 kw.-hr.	22.0
(2) Power used for dept and Xmas lighting	268,000 kw.-hr.	0.7	287,000 kw.-hr.	287,000 kw.-hr.	0.0
(3) Sales of energy	29,956,000 kw.-hr.	16.07	34,772,000 kw.-hr.	34,772,000 kw.-hr.	0.0
(4) Total gen. and purch	34,867,000 kw.-hr.	16.03	40,459,000 kw.-hr.	39,293,000 kw.-hr.	1,266,000 kw.-hr.
(5) Efficiency (per cent)	87.9	—1.5	86.4	89.2	2.8

Primary Service Methods

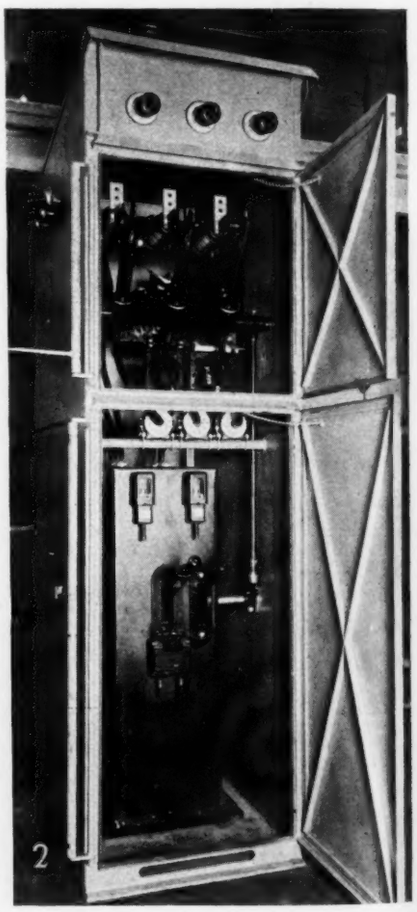
By L. W. CLARK
The Detroit Edison Company



Types of service facilities

(a) Single radial feed with fuses
(b) Single radial feed with circuit breaker
(c) Double feed, manual disconnect throwover
(d) Double feed, automatic two-circuit breaker throwover
(e) Double feed, loop line
(f) Multiple feeds, multiple bus sections

ANY Detroit Edison customer located outside of the downtown area of Detroit and having greater than 100 kw. demand can economically purchase 4,800-volt power under the primary rate as compared with the general secondary power rate. There are several different types of primary installations designed to accommodate different classes and sizes of customers. In all cases, irrespective of the type of installation, the customer furnishes and installs all necessary primary equipment, including the bus work, disconnects, stepdown transformers, etc., except an automatic oil circuit breaker or power fuses, which are furnished by the company and which form the connecting link between the customer's installation and the company's distribution.



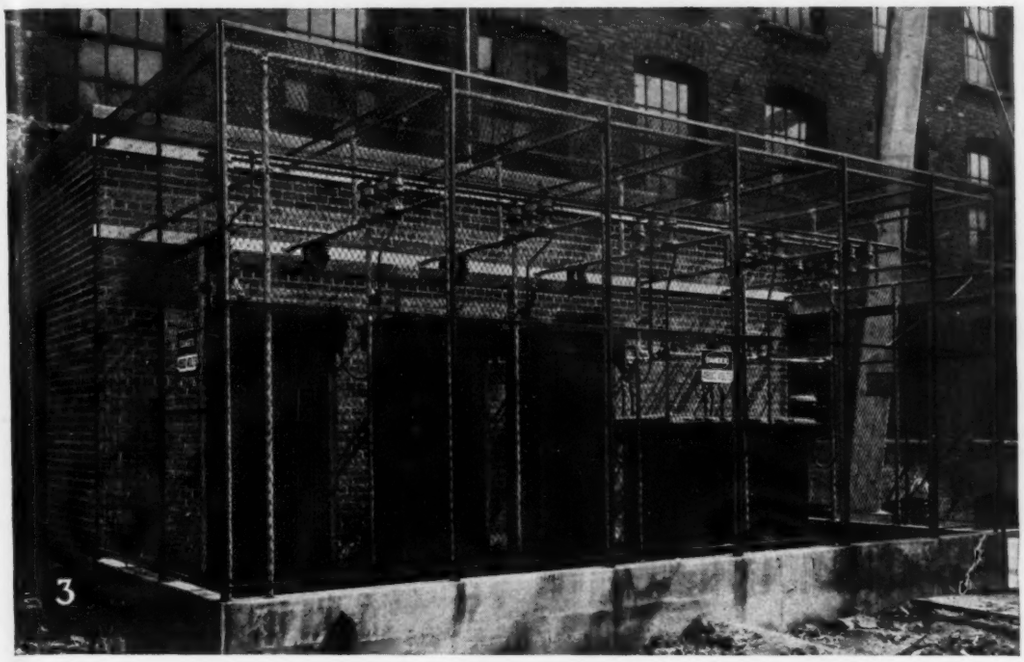
1 FUSED PRIMARY INSTALLATION—Simplest and cheapest form of installation consists of a bank of transformers mounted outdoors on a concrete slab and protected by primary fuses. It is a very common method of serving the small industrial customer whose load does not exceed about 225 kw. The metering transformers are inclosed in an outdoor box and the meters mounted indoors in the customer's building.

With such an installation, the customer cannot restore service himself in case of transformer or primary trouble, but must notify the company, which will dispatch a troubleman to replace the primary fuses and, if possible, restore service.

The transformers, although the property of the customer, are maintained under company supervision and the installation is technically considered a company substation. In this way the 240-volt service from the transformers to the customer's plant, rather than the 4,800-volt wires from the street, is considered to be the incoming service. Thus, the Code requirements are fulfilled without the necessity of installing a 4,800-volt oil circuit breaker ahead of the transformers.

2 OUTDOOR CUBICLE—For the customer whose load exceeds the capacity of the fused service or who desires to be able to restore service himself in case of trouble, the single radial feed with an oil circuit breaker is proposed. The breaker can either be mounted in an outdoor steel house, as shown in this picture, or in a brick-constructed primary house. Where there are no branch circuits to be provided for, the steel cubicle is the most economical.

The 4,800-volt leads enter at the front and leave the house from either side or the rear. The gang-operated disconnects are mechanically interlocked with the circuit breaker. There is a door in the rear of the house to provide access to metering transformers. Only four or five such cubicles

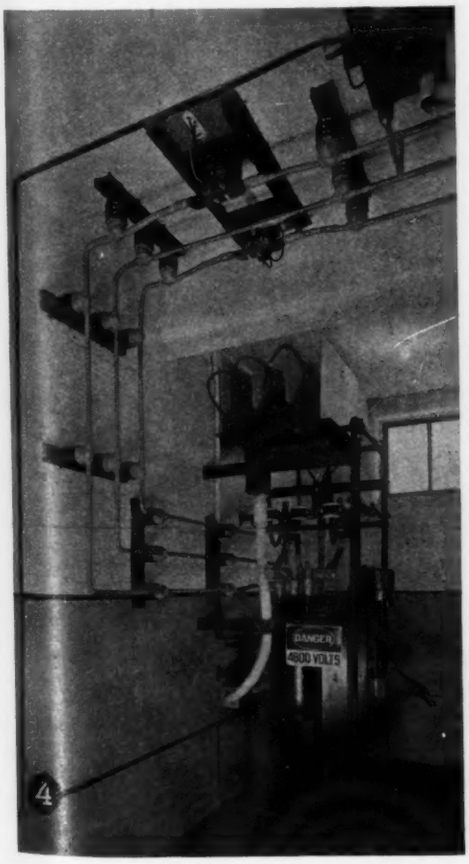


have been installed, because most customers have several circuit positions to provide for, thus requiring the larger brick house.

In several instances, temporary service has been provided, utilizing the steel house because of its high salvage value. The company has two such houses which have been sold and bought back several times in the past five years for such temporary installations.

3 OUTDOOR BRICK PRIMARY HOUSE —Where circuit positions are necessary additional steel cubicles increase the cost to such an extent that a brick house which will accommodate the incoming master breaker and at least two outgoing circuit position breakers is usually proposed.

In the installation shown the incoming service is by means of an underground cable from the overhead line in the street, but where possible it is preferable to continue the overhead construction all the way to the primary house. This house has space for the master breaker and will accommodate five or six outgoing circuits feeding transformers at other locations in the plant. When a transformer bank is located alongside a building several stories high it is protected by a grading across the top as well as on all sides, as shown here.



4 MANUAL DISCONNECT THROWOVER—There is a certain class of customers, such as telephone exchanges, small hospitals, theaters and apartments, that need a type of service which will assure them freedom from any prolonged service interruptions. Where such customers are in an overhead area a small secondary emergency feed for essential lighting is sometimes all that is needed for throwover service. In underground areas and where complete throwover facilities are desired the type of service shown has proven both economical and satisfactory.

Here are two incoming 4,800-volt cables which receive their power from separate bus sections at the substation. In some cases the cables are tapped from overhead power lines, while in other cases underground lines may be branch-jointed to serve several such customers. The disconnect is mechanically interlocked with the oil circuit breaker to insure that the breaker is always in the open position before operating the disconnect.

As a further precaution, the disconnect is well baffled, not only with baffles between phases but also with a baffle between the disconnect clips of the two incoming services. This center baffle is provided with slots to allow the disconnect blades to pass through from one side to the other. The open bus from the breaker continues to an adjacent vault in which are placed the stepdown transformers. Metering transformers are mounted on the ceiling.

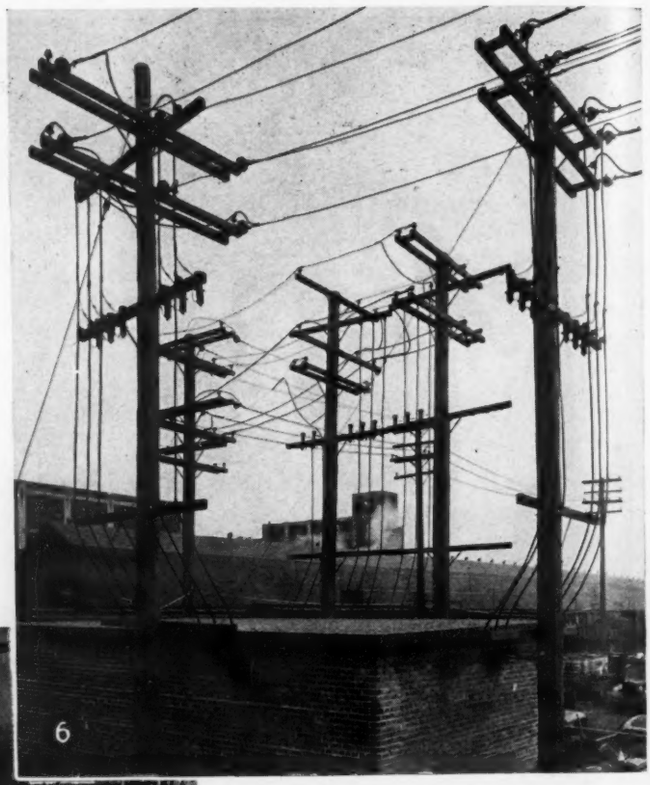
This form of service is entirely satisfactory where it is permissible to have a possible service interruption of a moment or so, just long enough to allow the customer's engineer to operate the disconnect and throwover to the auxiliary feed.

5 AUTOMATIC TWO-BREAKER THROWOVER—Where the delay of manual throwover is not permissible, the automatic two-breaker throwover is employed and outage time is reduced to a

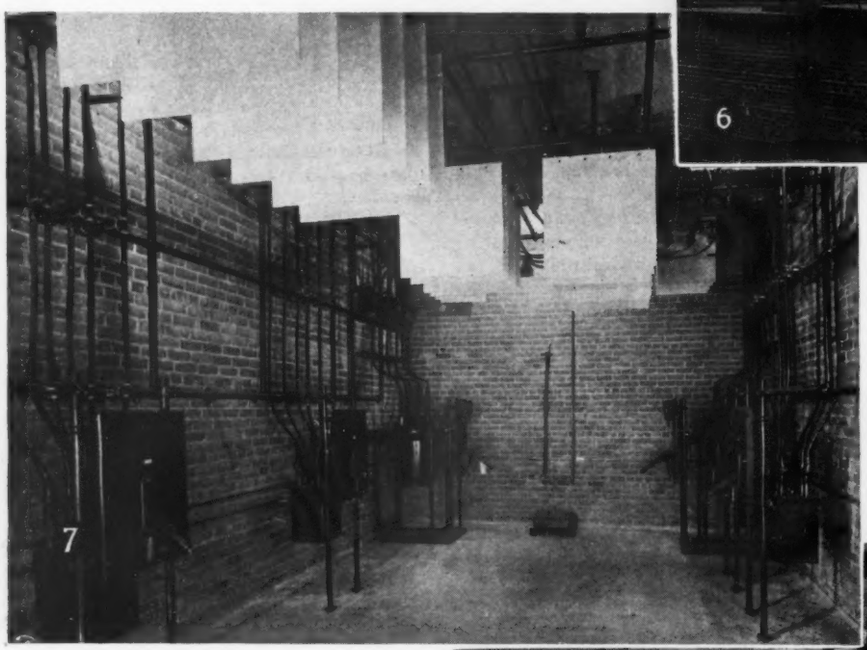
matter of about two seconds. The added protection of steel cell construction is used.

Customers, such as large hospitals, theaters, hotels, etc., outside of the downtown area are served in this manner. In the downtown district, with many such customers located in a relatively confined area, the loop form of service is more economical in the use of 4,800-volt cable. Each loop power line serves from four to six buildings.

The cables are protected by pilot wires in such a way that no service is interrupted in case of cable failure. Each loop also has an emergency feed from a second substation area so that in the remote contingency of a substation failure the loop customers are not without service for more than a few minutes. Present-day loop installations are of steel cell construction similar to that used for automatic two-breaker throwover installations.



6 MULTI-FEED INDUSTRIAL INSTALLATION—Here is an outside view of an industrial installation served by two overhead lines and having five outgoing overhead circuits to transformer banks located at different parts of the plant. Such an installation is not particularly good looking, but it is of low cost and the transformer banks can be easily moved about to give good service under the frequently changing conditions in a modern industrial plant. An underground distribution system, while eliminating the unsightly overhead wires, is not only expensive, but must also stay put when once installed.



8 STEEL CUBICLE INDUSTRIAL INSTALLATION—This view shows a class of steel cubicle construction which is being used to some extent for industrial applications. This particular installation has the transformers located in the same room with the switchgear, a practice which is not usually recommended, particularly if the switches are mounted in the open on pipe racks. Although the company is in full accord with the use of metal-clad construction, only a few plants have used it due to its cost.

7 INDUSTRIAL PRIMARY HOUSE—Interior view of primary house with two company-owned master breakers at the far end and customer's circuit breakers mounted along both walls. The bus work consists of No. 4/0 high-grade rubber-insulated wire mounted on pin type insulators. Double-throw disconnects with transite baffles between phases are provided for each circuit position. This type of construction is not only very economical but can be changed about easily as the need may arise.

It is our opinion that such a class of construction with reasonable space between line positions is entirely adequate for most industrial installations. The circuit position breakers are non-automatic so that only the incoming line breakers need have adequate rupturing capacity for primary faults. With all 4,800-volt plant circuits originating from a centrally located primary room, a faulty circuit can be quickly located and cleared.

Case History of a Water-Heating Group

Analysis of Usage by Electric Water Heater Customers Results in Basic Data Which Are Converted Into Consumption and Cost Figures

By ROY THURMAN

Indianapolis Power & Light Company, Indianapolis, Ind.

ON DECEMBER 16, 1936, the Indianapolis Power & Light Company had 1,000 customers using automatic electric water heaters. At that time a survey of the water heater data cards was made and the installation information covering these accounts was tabulated.

It was found that 878 of these customers had used the heaters long enough to attain normal operating conditions and did not have any abnormal outside uses for service which would affect the accuracy of the resultant figures. Therefore, all of the operating data in this report are based on these 878 customers.

The rate used covers an eight-hour off-peak heating period from 10:30 p. m. to 6:30 a. m. daily, and since upper unit switches are installed on all heaters practically all of the water heating is done on the off-peak rate. The rate for this period is 2 cents per kilowatt-hour for the first 50 kw.-hr. per month and 1 cent per kilowatt-hour for all over that amount per month. This rate includes all service used in the home during the off-peak hours, so an allowance has been deducted from the total night readings to compensate for other use in the home. These deductions are based on the number of persons in the family and are 15 kw.-hr. per month for two and three persons per family, 20 for four and five, 25 for six, 30 for seven and eight and 40 for more than eight. Readings taken in the field indicate figures are very close to the actual conditions.

When a water heater is installed the customer has the option of being

Table I—Distribution of Tank Sizes

Tank Size, Gal.	Number Heaters	Number Customers	Per cent of Total	Total Kw. Connected	Total Gal. Capacity
40....	1	1	0.1	1.5	40
50–52..	20	20	2.2	30.0	1,000
66....	35	35	3.9	70.0	2,310
80....	515	506	57.5	1,287.5	41,200
86....	77	76	8.6	231.0	6,622
110....	60	60	6.7	210.0	6,600
120....	117	111	13.0	468.0	14,040
140....	72	69	8.0	360.0	10,080
Total..	897	878	100.0	2,658.0	81,892

Kw. connected per customer	3.02
Kw. connected per heater	2.96
Av. kw.-hr. per month per customer	306
Load factor during 8 hours off-peak	42.2
Watts connected per gallon	32.5
Av. heater capacity — gal	91.2

Table II—Number and Size of Heaters

Direct connected (no furnace coil)

Size Heater	Number of Heaters	Number of Customers	Total Kw. Connected	Total Gal. Capacity
50–52..	12	12	18	600
66.....	17	17	34	1,122
80.....	234	230	585	18,720
86.....	32	31	96	2,752
110.....	24	24	84	2,640
120.....	68	64	272	8,160
140.....	33	31	165	4,620
Total.	420	409	1,254	38,614

Av. kw. connected per customer	3.07
Av. kw. connected per heater	2.99
Av. kw.-hr. used per month per customer.	343
Load factor during 8 hr. off-peak	46.5
Av. heater capacity — gal	92
Av. amount water heated per night — gal.	45.7
Watts connected per gallon (one unit)	32.5
Av. percent tank capacity used per day	49.6

Table V—Servant Service

Number of Servants	Number of Customers	Per Cent of Total
No servants	579	65.9
1	243	27.7
2	48	5.5
3	7	0.8
4	1	0.1

The servant question is important from the standpoint of hot water uses. Our cards, therefore, indicate how many servants each one of our customers employs and each one of these is counted as two in our operating data tabulation.

Table III—Number and Size of Heaters

Series connected (with furnace coil)

Size Heater	Number Heaters	Number Customers	Total Kw. Connected	Total Gal. Capacity
40.....	1	1	1.5	40
50–52..	8	8	12.0	400
66.....	18	18	36.0	1,188
80.....	281	276	702.5	22,480
86.....	45	45	135.0	3,870
110.....	36	36	126.0	3,960
120.....	49	47	196.0	5,880
140.....	39	38	195.0	5,460
Total.	477	469	1,404.0	43,278

Av. kw. connected per customer	2.99
Av. kw. connected per heater	2.94
Av. kw.-hr. used per month per customer.	272
Load factor during 8 hr. off-peak	37.9
Watts connected per gallon	32.5
Av. heater capacity — gal	90.5

Table IV—Distribution of Larger Appliances Among 878 Water Heater Customers

Appliance	Total	Per Cent of Total
Refrigerators	804	91.5
Ranges	595	67.7
Water pumps	408	46.4
Oil burner or stoker	245	27.9
Water softener	135	15.3

The information given in this table very clearly indicates that up to the present time water heaters were being used by the higher income customers since most of them have refrigerators and ranges and a very good percentage have oil burners or stokers.

Table VI—Seasonal Variation in Water Heater Consumption

Month	Average Kw.-Hr.-No Furnace Coil	Average Kw.-Hr. with Furnace Coil	Average City Water Temperature Deg. F.
January	367	261	32
February	372	198	32
March	357	222	42
April	366	266	49
May	360	334	67
June	352	364	73
July	305	323	82
August	293	299	82
September	308	306	74
October	334	295	58
November	339	233	43
December	368	217	35
Average	343	272	55.8

Table VII—Seasonal Variation in Kw.-hr. Consumption of Water Heaters

Direct connected (no furnace coils)

Month	Number in Family 2	3	4	5	6	7	8	Over 8
January	252	294	289	387	448	523	619	860
February	261	293	286	416	411	555	657	743
March	248	257	279	415	434	524	594	691
April	243	274	292	412	448	562	569	750
May	238	282	315	386	430	493	616	718
June	231	272	308	365	429	482	637	723
July	205	243	275	325	359	367	523	623
August	205	244	258	312	350	333	482	593
September	203	246	263	321	393	390	499	681
October	208	249	280	356	463	449	544	718
November	226	248	287	363	442	460	587	694
December	226	281	304	393	474	518	657	794
Average	229	265	286	371	423	471	574	706

In order to get a true average of the kilowatt-hours used by different-sized families it is necessary to average each group monthly, then use the yearly total divided by twelve to get the real monthly average. This eliminates the difficulty caused by seasonable changes in kilowatt-hours used and readings from a large number of heaters installed less than a full twelve months. Tables VII and VIII give us this accurate data for the direct connected and series hook-up.

Table VIII—Seasonal Variation in Kw.-hr. Consumption of Water Heaters

Series connected (with furnace coils)

Month	Number in Family 2	3	4	5	6	7	8	Over 8
January	147	154	212	216	167	362	303	229
February	116	152	206	239	176	361	276	230
March	125	174	215	275	213	455	311	151
April	167	210	243	295	307	494	409	280
May	213	274	277	369	385	566	474	679
June	245	289	304	433	444	527	499	689
July	230	256	287	362	366	470	428	461
August	198	243	268	332	346	406	429	606
September	195	246	273	327	363	451	463	623
October	192	242	267	304	350	439	443	553
November	155	185	225	242	273	320	381	380
December	140	164	221	221	241	303	370	361
Average	177	216	250	301	303	430	399	442

Table IX—Monthly Net Water Heater Consumption

Direct connected (no furnace coils)

No. in Family	No. Customers	Customer Months	Av. Kw.-Hr.	Av. Kw.-Hr. per Person	Av. Net Bill	Cents per Day Av. Cost per Person
2	91	841	229	115	$2.64	4.4
3	63	682	265	88	2.90	3.2
4	77	915	286	72	3.16	2.6
5	75	793	371	74	4.01	2.6
6	41	436	423	70	4.48	2.5
7	26	318	471	67	4.91	2.3
8	17	107	574	72	5.94	2.5
Over 8	19	214	706	.....	7.16	.....
	409	4,306	343	78.2	$3.73	2.8

Series connected (with furnace coils)

No. in Family	No. Customers	Customer Months	Av. Kw.-Hr.	Av. Kw.-Hr. per Person	Av. Net Bill	Cents per Day Av. Cost per Person
2	68	574	177	89	$2.12	3.5
3	95	933	216	72	2.51	2.6
4	113	1,095	250	63	2.80	2.3
5	74	660	301	60	3.31	2.2
6	52	434	303	50	3.28	1.8
7	31	266	430	61	4.50	2.2
8	22	258	399	50	4.19	1.7
Over 8	14	134	442	.....	4.52	.....
	469	4,354	272	62	$3.02	2.26

We have used the data from customer billings from the date the hot water heater was installed to secure the average billing per family of various sizes. These are necessarily divided into those who do not use furnace coils and those who do use them during the winter period. It is rather surprising that, taking the entire number of customers under these two groups, the average difference in cost is 71 cents per month, or $8.52 per year. Evidently many of the customers who use furnace coils are not getting a great deal of benefit, probably due to limed up coils and piping.

Table X—Use of Hot Water

Month	Deg. F. Water Temp.	Deg. Rise to 156°	B.t.u. per Gal.	Gal. Heated per Kw.-Hr.	Av. Kw.-Hr. per Mo.	Av. Gal. per Mo.	Av. Gals. per Day
January	32	124	1,032	3.22	367	1,182	39.4
February	32	124	1,032	3.22	372	1,198	39.9
March	42	114	950	3.50	357	1,248	41.6
April	49	107	892	3.73	366	1,365	45.5
May	67	89	742	4.48	360	1,612	53.7
June	73	83	692	4.81	352	1,693	56.4
July	82	74	616	5.40	305	1,645	54.8
August	82	74	616	5.40	293	1,580	52.7
September	74	82	684	4.86	308	1,500	50.0
October	58	98	817	4.07	334	1,360	45.3
November	43	113	942	3.53	339	1,196	39.7
December	35	121	1,010	3.29	368	1,210	40.3
Average	55.8	100	833	4.02	343	1,382	46.1

By adjusting the gallons heated per kilowatt-hour to allow for varying monthly temperatures of the incoming cold water, we can determine the monthly and daily gallons of hot water used by the average customer. The figures in this table are derived from 409 customers who do not use furnace coils.

Table XI—Seasonal Variation in Average Gals. Use of Hot Water per Day

Direct connected (no furnace coils)

Month	Number in Family 2	3	4	5	6	7	8	Over 8
January	27.0	31.6	31.0	41.5	48.1	56.1	66.4	92.3
February	28.0	31.4	30.7	44.6	44.1	59.5	70.5	79.6
March	28.9	30.0	32.6	48.4	50.6	61.1	69.3	80.6
April	30.2	34.1	36.3	51.2	55.6	70.0	70.7	93.3
May	35.5	42.0	47.0	57.6	64.1	73.5	92.0	107.0
June	37.0	43.6	49.4	58.5	68.8	77.4	102.1	115.8
July	36.9	43.7	49.5	58.5	64.6	66.0	94.1	112.0
August	36.9	43.9	46.4	56.1	63.0	60.0	86.8	106.8
September	32.9	39.8	42.6	52.0	63.7	63.2	81.0	110.0
October	28.2	33.8	38.0	48.2	62.7	60.8	73.7	97.3
November	26.6	29.2	33.8	42.7	52.0	54.1	69.1	81.7
December	24.8	30.8	33.3	43.1	52.0	56.8	72.1	87.1
Average	30.6	35.3	38.4	49.4	56.4	62.8	76.5	94.1

The daily average use of hot water by families of various sizes for the different months is given in this table. It is interesting to note that the summer use of hot water is from 40 to 60 per cent greater than the winter use.

billed on the range rate for day-time service. This is 5.75 cents each for the first 50 kw.-hr. per month, 3.8 cents each for the next 50 and 2.5 cents each for all over 100. This billing covers the period from 6:30 a. m. to 10:30 p. m. The minimum on this rate is $2 per month. The minimum on the night off-peak rate is also $2 per month for the period dating from March 15 to November 15. From November 15 to March 15 there is no minimum on the off-peak rate. This allows the customer, if he so desires, to use his furnace coils without being penalized by paying for more than he uses.

The rate schedule limits the maximum connected wattage per heater to 30 watts per gallon capacity. The standard size unit closest to this figure is used. Both top and bottom units are the same wattage.

A study of the charts and tables reveals rather interesting data as to the customers' usage of hot water and, correspondingly, of electric service.

First of all, the influence of the temperature of incoming city water is shown in Figs. 1 and 2. In Fig. 1 the scale of water temperature is inverted before plotting and this permits the eye to observe readily the extent to which the average consumption follows the temperature curve, especially where no furnace coil is utilized.

In the lowest curve, showing average usage by months, it is seen that the use of a furnace coil can reduce consumption by as much as 170 kw.-hr. per month.

In Fig. 2 we have plotted city water temperatures, again compared to hot water usage per month and kilowatt-hour usage per month. It will be noted that from a January average of 1,180 gal. per month usage of hot water rises as high as 1,700 gal. per month in the summer time. The figures in Fig. 2 relate to 409 customers who do not use a furnace coil. The drop in summer time kilowatt-hour consumption is much less than the magnitude of the furnace-coil winter-time drop, as will be seen by referring back to Fig. 1. Nevertheless, the comparison in Fig. 2 does show very clearly the effect of city water temperature on reducing electric consumption despite the increased usage of hot water.

The distribution of sizes of water tanks is given in Table I to show the predominance of the 80-gal. size. Tanks of this size provide the storage capacity desirable when, as in our case, nearly 46 gal. of water is to be heated at night, as shown in Table II.

OPERATING DATA SUMMARY

Water heater customers included in study	878
Water heaters in use by 878 customers	897
Number of twin installations	19
Number of customers direct connected (no furnace coil)	409
Number customers series connected (with furnace coil)	469
Av. mo. water heater kw.-hr. per customer (no furnace coil)	343
Av. mo. water heater kw.-hr. per customer (with furnace coil)	272
Av. mo. water heater kw.-hr. per customer (all customers)	306
Av. mo. net water heater bill (no furnace coil)	$3.73
Av. mo. net water heater bill (with furnace coil)	$3.02
Av. mo. net water heater bill (all customers)	$3.36
Av. gallon hot water used per person per day	10.4
Av. kw. connected per customer (1 unit per heater)	3.02
Av. load factor over 8 hr. off-peak (no furnace coil)	46.5
Av. load factor over 8 hr. off-peak (with furnace coil)	37.9
Av. load factor over 8 hr. off-peak (all customers)	42.2
Av. city water temperature, deg. F.	55.8
Per cent of water heated to total water purchased	25.45
Number of water heaters installed 1935	377
Number of water heaters installed 1936	679
Per cent increase 1936 over 1935	80.1

INSTALLATION SUMMARY

Electric water heater customers	1,000
Electric water heaters in use	1,023
Twin installations	23
Total kw. connected (1 unit per heater)	3,014.25
Heaters, 80 gal. or larger, per cent	92
Average gallons capacity of heaters	90.6
Connected direct (no furnace coil), per cent	49.3
Connected series (with furnace coil), per cent	50.7
Heaters on sale contract, per cent	38.4
Heaters on rental contract, per cent	61.6

The data in the tables are presented to show the facts behind the averages, as developed from our study of water heating load, and practically all data are self-explanatory. For example, the

[*Continued on page 134*]

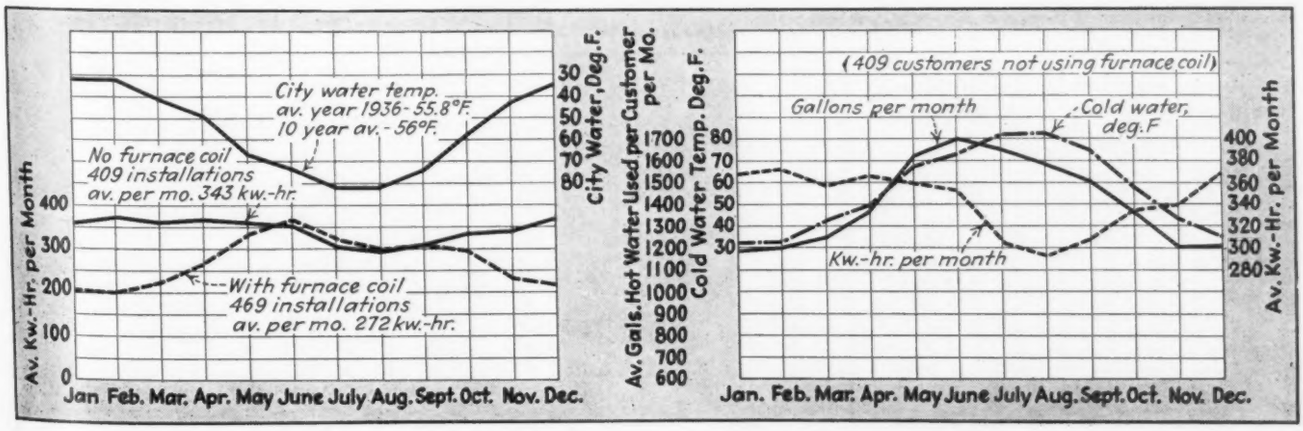

City water temp.
av. year 1936-55.8°F.
10 year av.-56°F.
No furnace coil
409 installations
av. per mo. 343 kw.-hr.
With furnace coil
469 installations
av. per mo. 272 kw.-hr.
Av. Kw.-Hr. per Month
City Water, Deg. F.
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

Fig. 1—Seasonal variation of water heater energy parallels strikingly the inverted curve of city water temperature during summer months (Table VI)

(409 customers not using furnace coil)
Gallons per month
Cold water, deg. F
Kw.-hr. per month
Av. Gals. Hot Water Used per Customer per Mo.
Cold Water Temp. Deg. F.
Av. Kw.-Hr. per Month
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

Fig. 2—Average gallons of hot water per customer month follows curve of city water temperature, while use of energy takes an inverted path

Converter Model Used to Train Operators

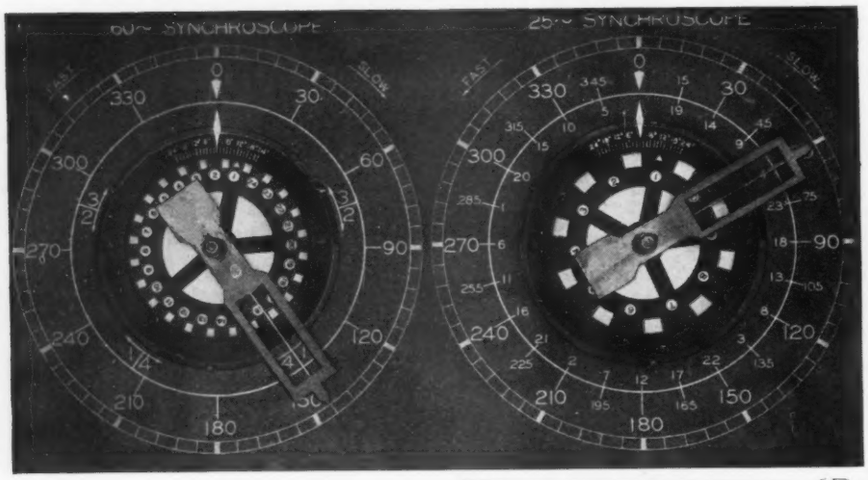
By F. OPPENHEIMER
System Chief Operator
Pennsylvania Water & Power Company, Baltimore

PROBLEMS of paralleling converters with systems of different frequency and controlling load on these machines are simply, vividly and quickly answered by means of a model of a frequency converter developed by the Pennsylvania Water & Power Company for training operating men.

A person looking at the face of this model in operation will see what would appear when viewing an actual operating converter illuminated by a stroboscope and having a synchroscope superimposed on it. When a real converter is running at synchronous speed the stroboscope would make it appear to be at standstill, and if it were below synchronism by 1 cycle (60-cycle side) the stroboscope would make it appear to be revolving in the slow direction 1/12 revolution per second, or the equivalent of one pair of poles per second, while the pointer makes one revolution.

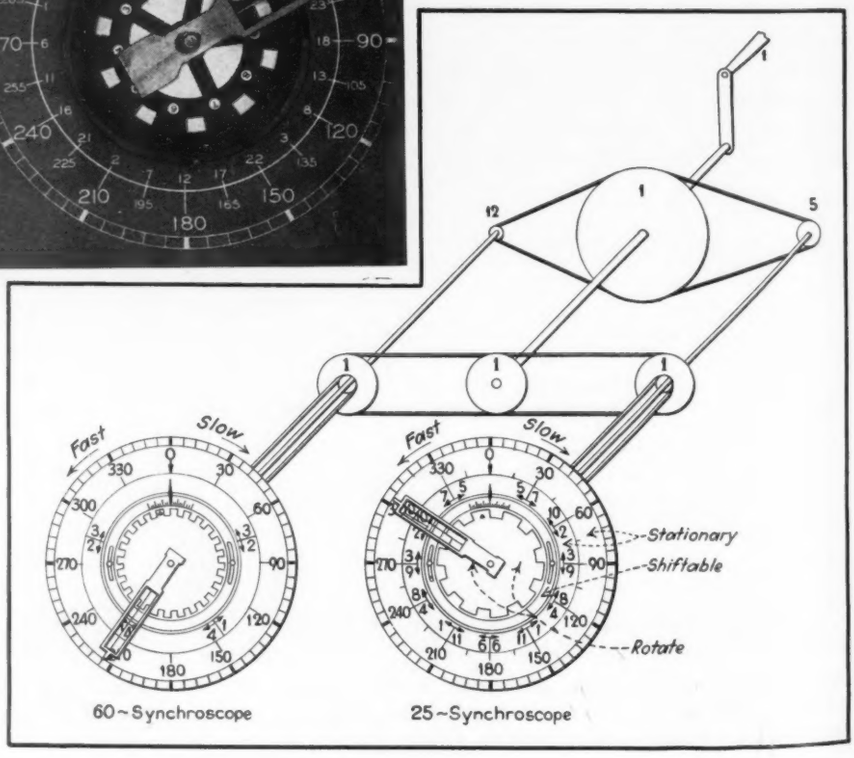
In demonstrating the starting of a converter the pointers may be set at 0 and rotor poles No. 1 at 0, then if the handle is turned in either direction until the 25-cycle rotor moves to pole No. 2 it will be observed that the 25-cycle pointer has made ½ revolution and the 60-cycle synchroscope pointer has moved 2.4 times this amount, or one revolution plus 72 electrical degrees. This represents what takes place when a converter started and synchronized on the 25-cycle side has "slipped" one pole; that is, the field on the 25-cycle side has opened and closed in the reverse direction, whereupon the machine pulls into synchronism with pole No. 2 at the 0 point. Thus it will be found that only when five poles have been slipped does the 60-cycle pointer indicate synchronism and the 60-cycle side may then be connected to its sys-

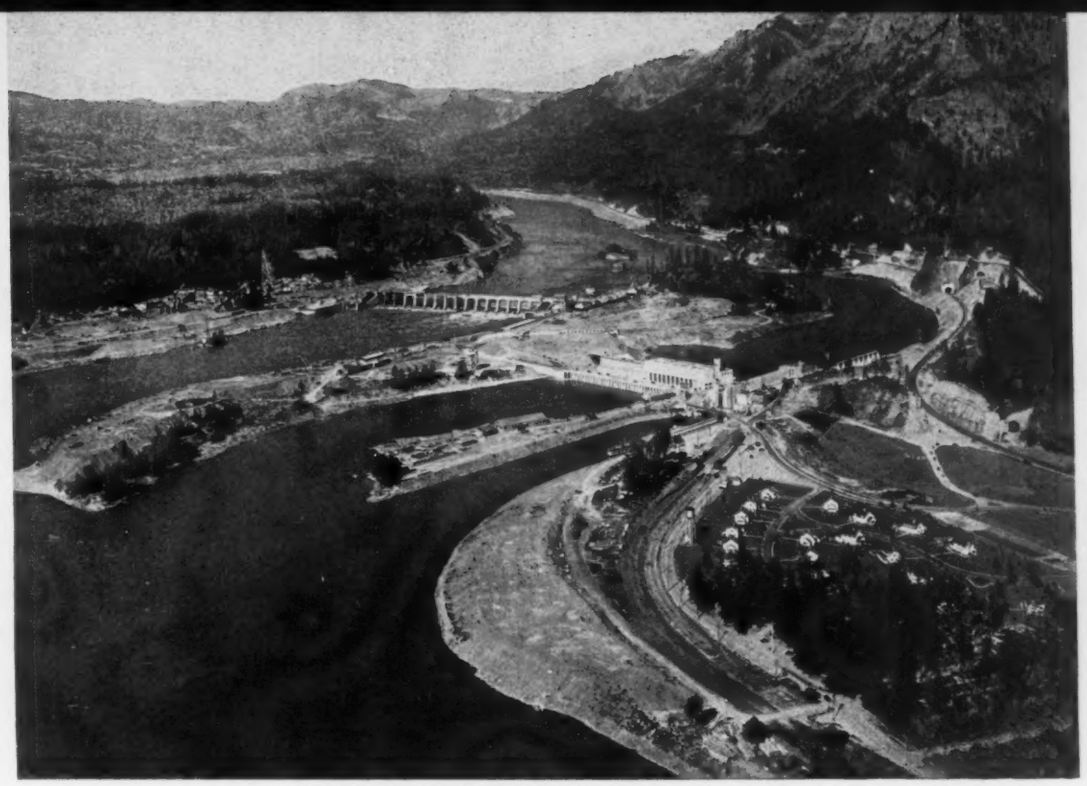
[*Continued on page 138*]



Frequency converter model demonstrates starting and synchronizing operations

In this model disks representing the two rotors of a 25- to 60-cycle frequency converter, which in the actual machine are on the same shaft, are mounted on separate shafts but geared to revolve at the same speed. Surrounding the rotor disks are stationary cardboards representing the dial of a synchroscope with figures added to show electrical degrees. Synchroscope pointers are caused to rotate on separate spindles geared so that the pointer representing the 25-cycle synchroscope makes five revolutions for every twelve revolutions of the 60-cycle pointer. This ratio of 5:12 corresponds to the ratio of the pairs of poles for a 300-r.p.m. converter on the 25- and 60-cycle sides respectively. A narrow circular band graduated in mechanical degrees surrounds the rotor disks just inside the synchroscope dial. This band represents the frame shifter on an actual converter and can be moved by hand through an arc of 24 deg. in either direction. The synchroscope pointers are mounted on their spindles in such a way that, with the spindle stationary, they can be released, rotated 180 deg. and reconnected to the spindle. This is for demonstrating that if the field of an actual converter is reversed a synchroscope pointer would shift through 180 electrical degrees.





Bonneville Designed for Problematical Loading

By L. E. KURTICHANOF
Consulting Electrical Engineer, Portland, Ore.

WHEN the Federal Administrator of Public Works on September 30, 1933, authorized Project No. 28, he initiated a series of problems in power plant electrical design which rarely, if ever before, have been met in power development. Their final solution will reach actuality early in 1938, when the first generating units at Bonneville Dam are scheduled to go into service.

Just what this service might be has, from the beginning, constituted a major difficulty in design. The location, size and nature of the prospective load was then entirely unknown. It is no better known today, with the plant nearing completion, than it was nearly four years ago, when actual construction in the field was begun.

The authority which was granted to the Corps of Engineers, U. S. Army, was to build a power plant, ostensibly incidental to a much-needed improvement to navigation, at an approximate location on the Columbia River. Office design and field construction work were initiated practically at the same time with the aid of such preliminary plans as were made some years earlier by the Corps of Engineers, U. S. Army, in their study of the resources of the Columbia River. Gradually, plans for the power house structure took shape, but with hydraulic considerations dominating to an extent which all but ignored need for the accommodation of associated electrical equipment other than main generators.

Thus work went forward, with structural design but a jump ahead of construction. There was constant demand for location and arrangement of equipment long in advance of anything like certain knowledge of even the type of equipment to be used.

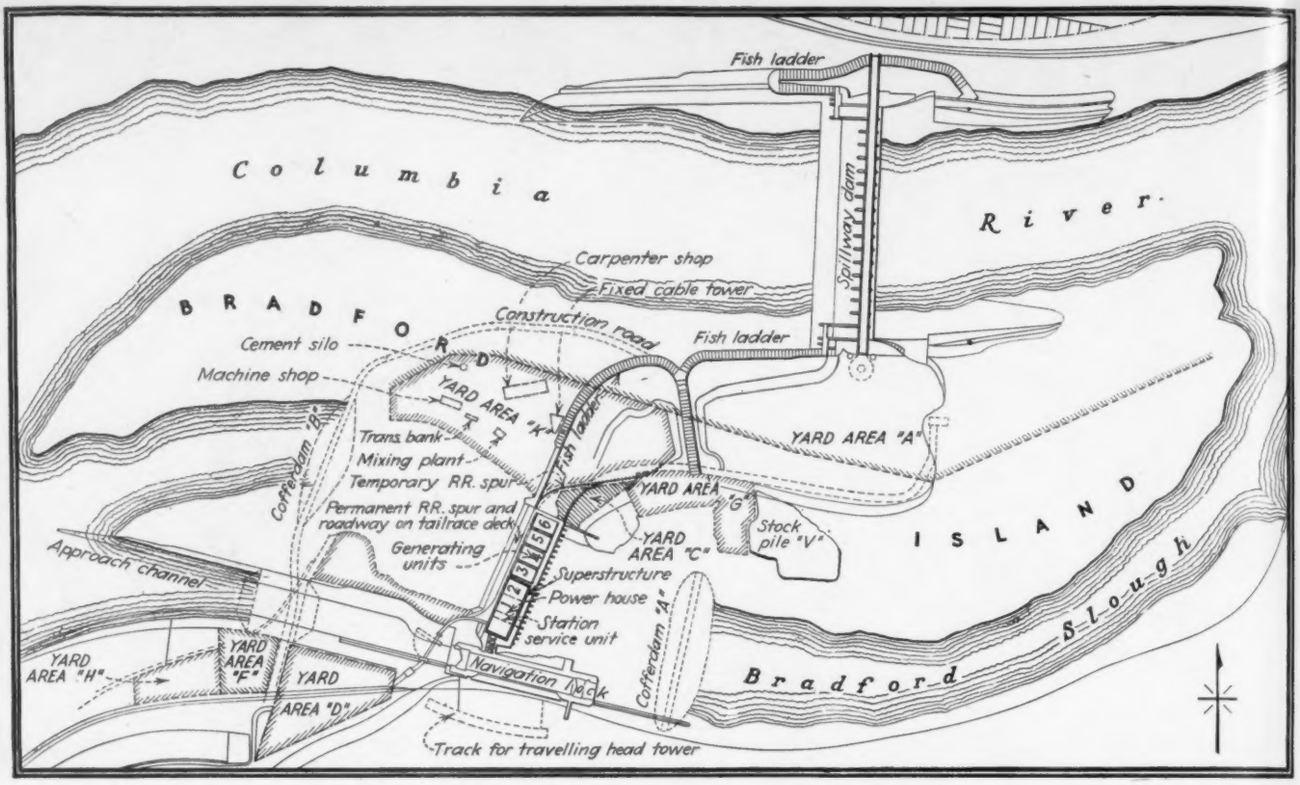
Numerous schemes of operation were studied in an effort to find one which would best fit into the government's policy when adopted. Out of these studies was evolved the general scheme governing the present plan, which in its major aspects involves generation at 13,800 volts and stepping up to 115,000 volts for transmission to centers of heavy load. Provision is made in the power house such that, by installing necessary equipment when needed, substantial loads in the near vicinity may be served at generated voltage.

Bonneville, Ore., the site of the work, is located on the Columbia River, 42 miles east of Portland. At this point the river flows in a general westerly direction in two channels separated by Bradford Island.

Interspersed with the hydro-electric and navigation elements are fishways to provide for migration of fish over the dam. These, estimated to cost about $6,500,000, consist of three sets of ladders and three double fishlocks, located on both banks and across the island.

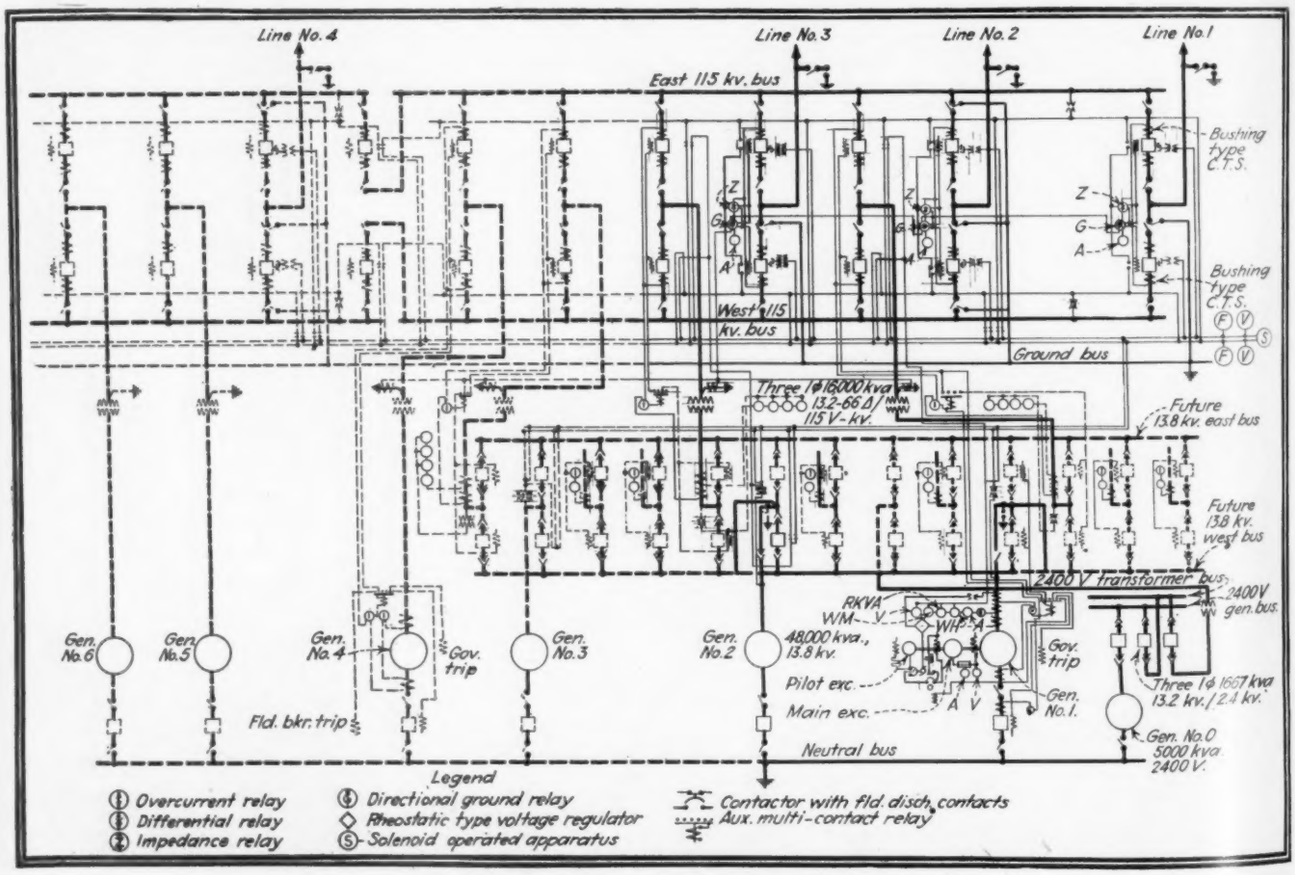
The power house

The power house structure consists of a completed building 207 ft. wide by 280 ft. long, to house two units, and a skeleton structure to accommodate four more. Provision has also been made for eventual extension to ten units.



Project embraces main dam, spillway, lock and fishways

Facing upstream, to one's left across the north channel extends the main dam—mass concrete, gravity type, 1,250 ft. long over all, with a 900-ft. spillway. Twelve 50 x 50-ft. and six 60 x 50-ft. steel, vertical-lift gates, 200 tons each, operated by two gantry cranes, allow discharge up to 1,600,000 sec.-ft., an estimated 1 in 10,000-year flood. The dam is 180 ft. wide at the base, 170 ft. high above lowest foundation. Elevations above sea level are: Gate sill, 24 ft.; service roadway over the dam, 99 ft.; normal pool water surface, 72 ft. Still facing upstream, next to the right is Bradford Island; then a quarter mile downstream across the south channel the power house constitutes a non-spillway type dam, and at the extreme right the highest lift navigation lock ever built.



Roof mounts 115-kv. bus and switch structure

Oil circuit breakers are of conventional type, rated 600 amp., 115 kv. with an interrupting rating of 1,500,000 kva. Disconnecting switches are manually operated and will be required to demonstrate their satisfactory performance when covered with 1½ inch thickness of ice.

Extremes of river flow were fundamental to the power house design. Records for the past 58 years indicate that flow varies from 40,000 sec.-ft., corresponding to a working head of 67 ft., to 1,170.000 sec.-ft., corresponding to a head of only 23 ft. Weighted average head is 54 ft. For base-load operation it was thus required that the units operate at high capacity under great variation of head.

Turbines

For this operation Kaplan turbines were selected. The ultimate ten units will be able to operate as a base-load plant about 75 per cent of the time. Physical size, which involved difficulties in water passage design, cost of the power house, smooth flow of water, weight on thrust bearings, etc., were factors considered in determining their capacity. Each is rated 60.000 hp., but can develop 66,000 hp. under favorable conditions of head.

Kaplan turbines of this size are unprecedented. Each has a rated water capacity of 12,200 sec.-ft. at 50-ft. head. An advance over previous practice in turbine construction was the arc welding of speed rings, bottom plates and throat rings from pressed plates.

The draft tube diameters are 23 ft. and each unit has five cast-steel runner blades projecting radially from the 10-ft. diameter runner hub. The cast steel hub contains the blade-operating mechanism immersed in 3,000 gal. of lubricating oil. Blade angle and wicket gate opening are controlled automatically, net head being transmitted by electrical means to the governor of each of the units.

Generators and transformers

Generator rating of the first two main units was determined largely by waterwheel capacity, and the selection of voltage grew out of careful consideration of the relative merits of 13.8, 22 and 34.5 kw. The first was found to be most economical for Bonneville.

The two main generators, rated 43,200 kw., 0.9 power factor, 13,800 volts, 75 r.p.m., three phase, 60 cycles, with directly connected main and pilot exciters, are being furnished by General Electric Company at the contract price of $572,440 each, erected in place and subject to complete tests, including short circuit and overspeed. The house service generator, rated 4,000 kw., 0.8 power factor, 2,400 volts, 257 r.p.m., three phase, 60 cycles, with directly connected main and pilot exciters, is being furnished by the Electric Machinery Manufacturing Company at the contract price of $61,473, similarly erected and tested.

All are provided with a conventional inclosed ventilating system. For extinguishing fires in the windings, carbon dioxide gas or similar equipment, supplemented by water nozzles arranged to cover the end turns of the stator coils and the air-gap, are provided. Class B insulation is used for all armature and field windings.

Excitation for each main generator will be furnished by a main exciter rated 375 kw., 250 volts and a pilot exciter rated 17 kw., 250 volts. No spare exciter is being provided. An automatic voltage regulator of non-continuously vibrating type is being furnished with each generator.

Kaplan turbine (S. Morgan Smith) on the way into the pit

Step-up transformers, three each per bank for each generator, are rated 16,000 kva., 13.2 kv. delta/66 kv. delta/115 kv. wye, single phase, 60 cycles. Location of these is on the headgate structure, each in a separate cell open at the top only. To prevent damage from ignition of oil lost through serious damage, a sump at each cell bottom discharges below tailwater surface.

A 5,000-kva. bank of three 1,667-kva., 13,200-2,400-volt, single-phase transformers will serve to supply the 2,400-volt station service bus from the 13.8-kv. bus as well as to step up from 2.4 kv. to 13.8 kv. when the house generator is operating in parallel with the 13.8-kv. bus.

Two 1,000-kva., 2,400-480-volt, three-phase transformers will serve the unit auxiliaries and station service power load.

All transformers are oil-immersed, inert gas filled, water cooled and were subjected to the usual tests plus impulse tests for the 16,000 kva.

Auxiliaries

Normally, power for station auxiliaries, dam, fishway and lock-operating equipment will be supplied through the bank of 5,000-kva., 13.8/2.4-kv. transformers fed from the 13.8-kv. bus. The house generator will be withheld except for emergency and peaking. The bank and house generator will connect to separate buses of a metal-clad, 2,400-volt, double bus structure. The two buses may be paralleled through a bus-tie breaker.

Load, at 2,400 volts, such as the two 200-hp. unwatering pumps and the 1,000-kva., 2,400-480-vole, three-phase transformers, is fed directly from either bus through duplicate circuit breakers. One feeder similarly connected runs through two 600/300-amp., single-phase induction regulators to provide regulated voltage on branch circuits throughout buildings and grounds.

Control storage battery consists of 120 seventeen-plate (Gould) cells in sealed glass, with Planté type positive plates, pasted negative plates. These float at constant voltage across a motor-generator set supplying the normal steady direct current load. Two three-unit motor-generator sets (Electric Products) are provided for charging.

13.8-kv. switchgear

Due to the requirement that provision be made for serving some load at generated voltage, a generator bus is necessary. It will be metal-clad, double-bus, double-breaker type with each conductor isolated from the others in its individual compartment. Similar metal-clad construction will be used in the entire run between the terminals of the generators and associated step-up transformers. Initially, this will be a single bus extending over seven circuit breaker positions: Two generators, two main transformer banks and three feeders. Only two circuit breakers are provided initially and are temporarily connected so as to enable switching the 5,000-kva. station service trans-

former bank to either of the two main generators.

The main oil circuit breakers are vertical lift, withdrawal type, solenoid operated, rated 3,000 amp., 15,000 volts, with interrupting capacity of 1,500,000 kva. at rated voltage. They consist of three single-pole elements in a three-pole assembly, with electrical mechanism for simultaneous elevating or lowering of all poles to connected or disconnected positions respectively.

These breakers are located in the bus and switch gallery, which is divided by partial walls extending from each side toward the center, thus forming pairs of open-fronted cells. Cells in which breakers will be placed for any one position of the double-bus scheme are located opposite each other.

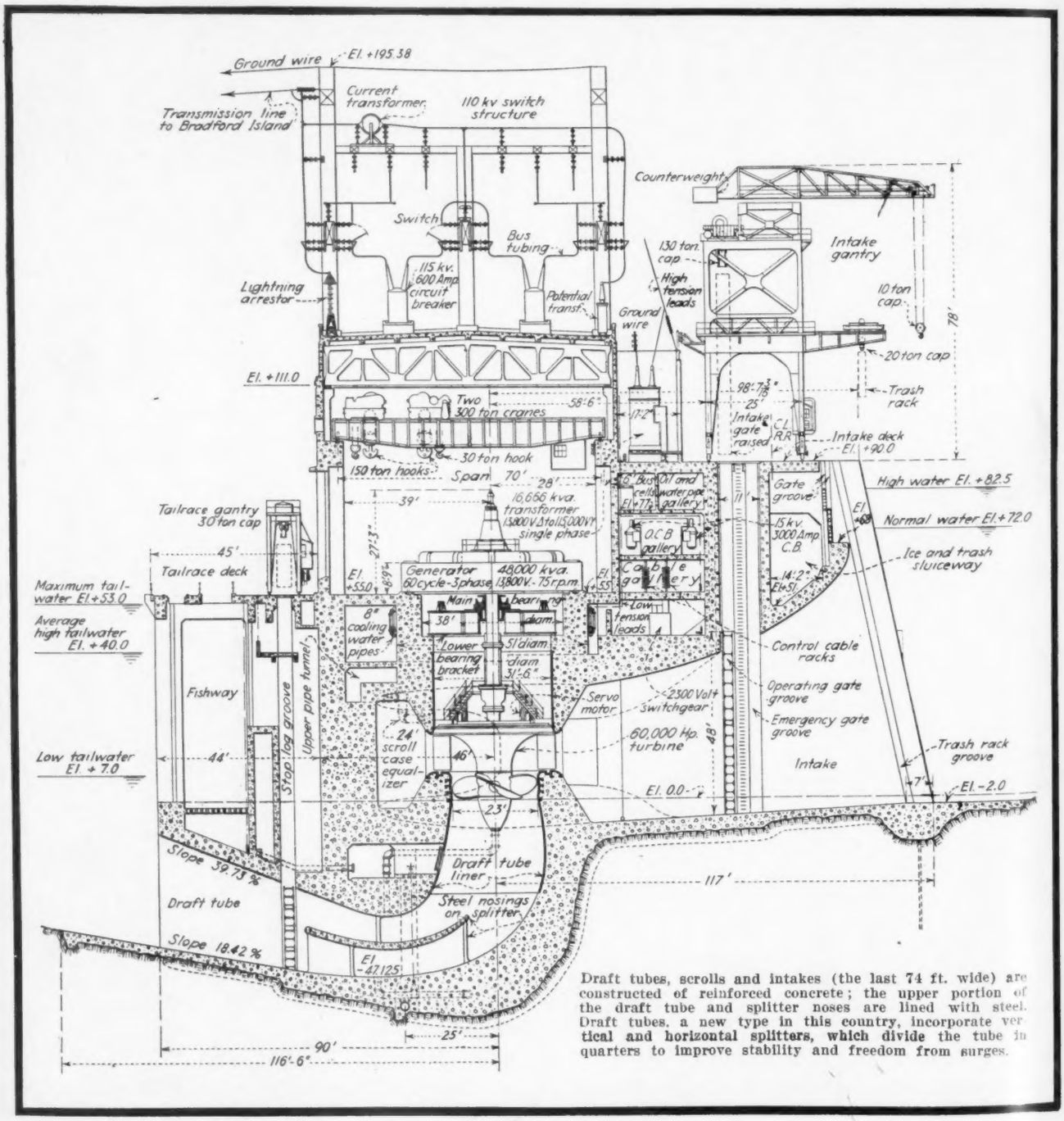
Because limited space prohibits removing breaker tanks while breakers are in their cells in disconnected position, a motor-propelled transfer truck and test rack are provided. The test rack will contain the same elevating mechanisms and control equipment as in the cells.

115-kv. switchgear

Due to the inconvenience of suitable site at ground level for a switching station and the relative high cost of developing one for the initial installation of generator capacity, the 115-kv. bus and switch structure will be located on the roof of the power house. Two buses, of rigid type, using tubular copper conductors, will be provided. Space on the structure now built will accommodate duplicate circuit breakers and vertically mounted, group-operated disconnecting switches for the control of two banks of step-up transformers and three transmission lines.

2,400- and 480-volt switchgear

The 2,400-volt switchgear is built in one continuous, metal-clad structure, with buses, taps and circuit breakers insulated for 15,000 volts, and is made up of fifteen bus positions and one induction regulator assembly. Each position is a metal-clad unit containing, each in an isolated compartment, three-phase buses, oil circuit breakers, instrument transformers and accessories.



Draft tubes, scrolls and intakes (the last 74 ft. wide) are constructed of reinforced concrete; the upper portion of the draft tube and splitter noses are lined with steel. Draft tubes, a new type in this country, incorporate vertical and horizontal splitters, which divide the tube in quarters to improve stability and freedom from surges.

Splitters provided in draft tubes

First in the arrangement are two buses, one to normal supply, the 5,000-kva. station service transformer bank, the other for emergency, to the station service generator with a bus-tie connecting the two. Following are seven positions for important feeders, the last through an induction regulator assembly to a five-position bus for feeders requiring close regulation. A by-pass is provided around the regulators. Feeders to the first seven positions are equipped with duplicate circuit breakers for connection either to the transformer or generator buses. Feeders in the last five positions are equipped with one circuit breaker and a disconnecting switch by-pass, connected respectively to main and transfer buses. A bus-tie circuit breaker is to connect these two and to serve as a spare.

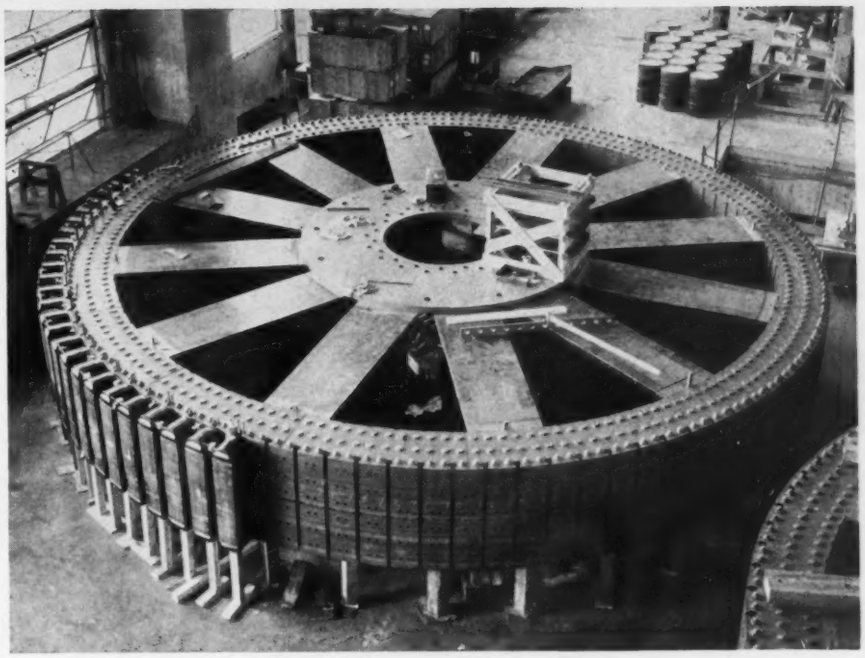
Two 600/300-amp., single-phase induction regulators and a circuit breaker on the feed and load sides of the group constitute the regulator assembly. Interlocking the circuit breakers prevents their operation except when the regulator is in neutral position.

Circuit breakers are solenoid-operated, vertical-withdrawal-disconnecting type for 15,000-volt service, all rated at 100,000 kva. interrupting capacity. Rating for the two main supply and one bus-tie positions is 2,000 amp., for feeder positions 600 amp.

The 480-volt switchgear is the main distributing center for all 480-volt, three-phase power for use in station service, navigation lock and fishways. Power to the switchboard will be supplied through two 1,000-kva., 2,400-480-volt, three-phase transformers and distributed through twenty principal feeders and twelve subfeeders. To provide for serving the 480-volt load from two different sources each transformer is connected through a circuit breaker to a main 480-volt bus extended to serve all principal feeders. A bus-tie circuit breaker will serve to parallel the two transformers and enable serving one or both buses from each transformer.

The assembly of buses, circuit breakers and associated devices is contained in a continuous, dead-front, metal-inclosed structure within which are separate compartments for the equipment of each principal circuit. The buses are extended in a metal inclosure to the terminals of the transformers.

Circuit breakers on the supply sources, bus-tie and principal feeders are air-break, solenoid operated. Those on the sub-feeders are air-break, manually operated type.



Generator rotor (on 40-inch shaft) weight 387 tons

Control switchboards

In the southeast corner of the power house at elevation 77 is the 42x60-ft. main control room. It is to accommodate only control switches, indicating instruments and such other devices as are essential to operation. Cubicles near each generator will be used for emergency control and contain graphic instruments, watt-hour meters, relays and voltage regulators.

Eventual extension of the power house to nearly 1,000 ft. indicated problems in meter, relay and control circuits and led to adoption of the dual scheme of control. Particularly to facilitate operations when this ultimate development is attained, the main control board will be equipped with miniature equipment.

Symmetrical association of generators, transformers and their controlling circuit breakers contributes to compactness in the cubicles. Control of electrical devices associated with the turbines and governors is mounted in the cabinet type inclosures housing the actuators and oil pump units associated with governors. These inclosures, in twin arrangement, are located near the generator control cubicles, thus providing closely grouped, convenient control for turbines and generators.

Principal items of the control switchboards are:

Two generator cubicles, one for each main generator.

One main control bench board.

One station service control board.

One graphic instrument board.

The last three are arranged on three sides of a hollow square in the main control room.

Station lighting

Unique in size and application will be the indirect lighting system for the main control room, which makes use of a plaster ceiling as a reflecting surface. This is suspended below the roof trusses and will be illuminated by equipment concealed behind the crane runway girders.

In the main control room the sound-

IMMEDIATE PROBLEM AT BONNEVILLE IS ECONOMIC

What loads will it serve and at what rates? What relation will it bear to other federal projects and how will it be administered? These are the questions that will be answered in the next few years.

Meanwhile, economic forecasts respecting the Bonneville project must rest on the latest estimates of cost. These are:

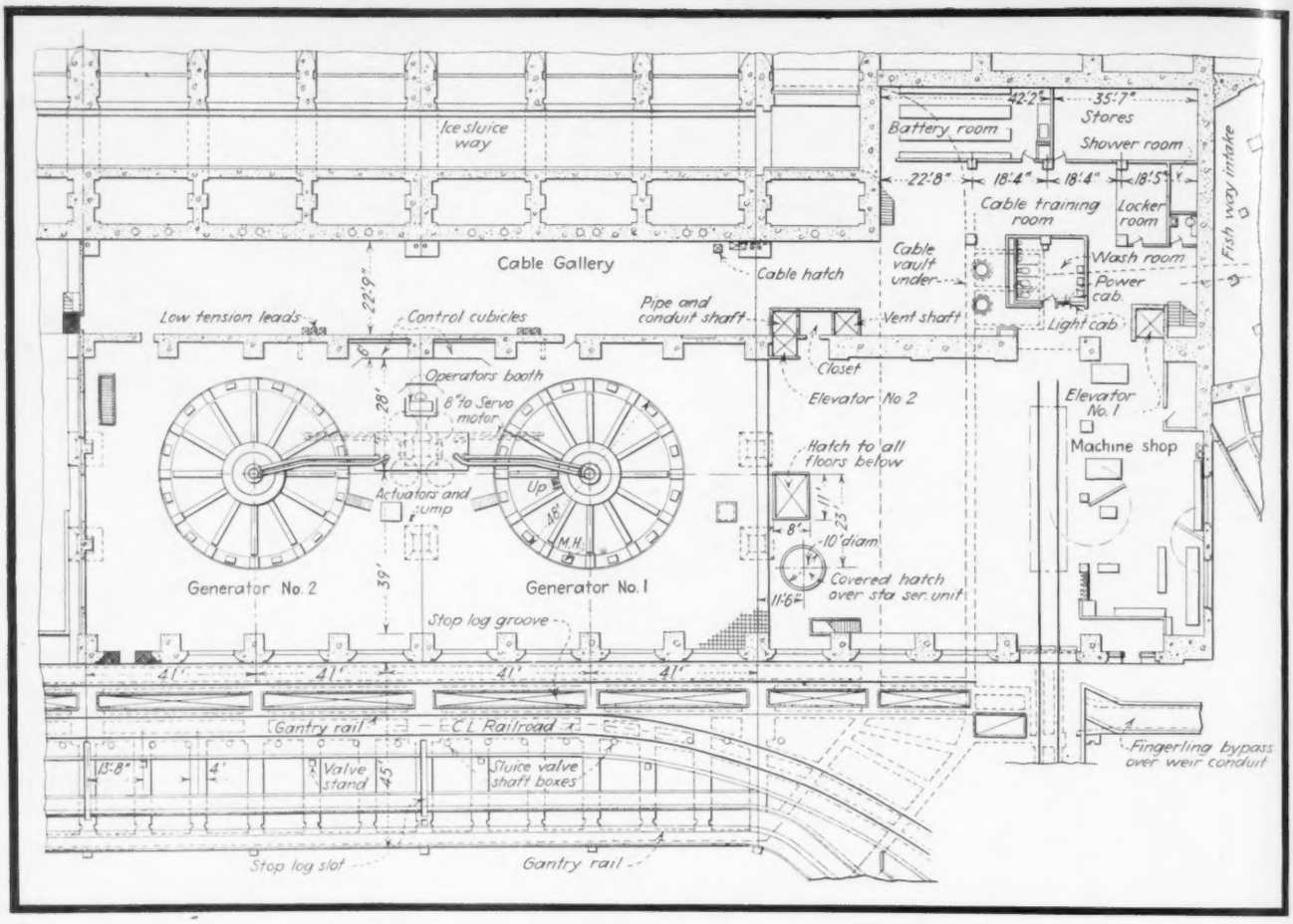
1. Dam and reservoir	$28,085,000
2. Buildings and grounds	976,000
3. Navigation lock	5,158,000
4. Fishways	6,553,000
5. Power house and equipment	10,218,000
Total	$50,990,000

Suggested Allocation of Costs to Power for Purpose of Determining Rates (Remainder to Be Charged to Navigation)

	Per Cent	
1. Dam and reservoir	50	$14,042,500
2. Buildings and grounds	50	488,000
3. Navigation lock	0	
4. Fishways	50	3,276,500
5. Power house, equip't	100	10,218,000
Total cost, 2-unit power plant		$28,025,000

Total and Unit Costs for Extensions From Two to Ten Units by Increments of Two

Number of units	Installed Cap., Kw.	Total Cost	Unit Cost
2	86,400	$28,025,000	$325
4	172,800	32,525,000	188
6	259,200	36,625,000	141
8	345,600	42,675,000	127
10	432,000	47,075,000	109



Generator overspeed possibility necessitates two guide bearings

Each generator is provided with a thrust bearing and an upper and lower guide bearing. Two guide bearings were specified on account of the unusual overspeed requirements. The overspeed possible under the worst conditions reaches 288 per cent of normal speed. The thrust bearings for the 43,200-kw. generators will be required to support a total load of 2,843,000 lb. each and are the General Electric Company's spring-supported type. The thrust bearing for the 4,000-kw. generator is the Kingsbury type. The rotating part of a main generator will weigh 775,000 lb. and will have a flywheel effect of 113,000,000 lb.-ft. squared. The total weight of a generator is 1,500,000 lb. The shaft of a main generator is 40 inches in diameter and has a hole 15 inches in diameter bored axially throughout its length for the accommodation of the oil-pressure pipe lines from the Kaplan head to the blade-adjusting mechanism.

proofed ceiling will be illuminated by a combination indirect system recessed in wall coves and by fixtures atop the switchboards. In the ceiling are flush-mounted units, with directive lenses, connected to the control storage battery to illuminate the boards and operator's desk in emergency.

Station heating

An electric system, with 1,000 kw. connected load, distributed at 480 volts, three phase, will be used for heating the power house. Half this load will be connected to heaters on the floor of the main generator room equipped with circulating fans discharging at the top. The remainder will be used for air heating and treating in the control and station service bays. In the control room and office space during hot weather outside air will be cooled, humidified, used and discharged outside.

Fishways

The fishway system consists of fish ladders and fish lifts using more than 100 motors aggregating nearly 900 hp. About 90 per cent of the motors are for reversing service to be used for operation of regulating gates and radial gates in the fish ladders and elevators, segmental and closure gates, radial gates and traveling water screens in the fish lifts. Motors operate at 480 volts, with control at 120 volts.

Spillway dam

Power for the dam is delivered over two 2,400-volt lines to two of the three dam control houses, which are located on both ends of the dam down-stream and one at the south end up-stream. Each down-stream control house has a 300-kva. transformer bank for 480-volt power and a 50-kva. transformer for 120/240-volt lighting. Automatic throw-over breakers are provided to transfer load in case one supply line fails. Control equipment for power and lighting circuits consists of air circuit breakers mounted in steel cubicles. Principal circuits can be fed and controlled from either or both ends of the dam.

Main loads at the dam are the two 350-ton gantry cranes. Each has a connected load of 185 hp. in motors and a 10-kva. transformer for lighting. In addition, each carries an independent, gasoline-driven power plant for emergency. Gate latches can be operated from the crane, being raised by thrustor motors, lowered by gravity.

Other loads at the dam are slot heaters located in six of the eighteen gates to prevent freezing, an automatic elevator to inspection tunnels 135 ft. below dam roadway, and lighting. Lighting is confined to illumination of roadway and approach ramps, two floodlights at each gate and an inexpensive system in the inspection tunnels.

Navigation lock

Since it was necessary to maintain a clear channel through the lock for ship passage, all wiring between sides had to be carried beneath the structure. This, coupled with the desirability of keeping machinery below the coping, gave rise to an intricate system of manholes.

Power is supplied at 440 volts, three phase, for operation and control and at 110-220 volts for lighting. Each voltage system, comprising two feeders, is arranged as a sectionalized ring bus with each feeder serving the machinery at each end of the lock. Entire load can be transferred from one to the other feeder, or a group of sub-feeders can be bypassed without disturbing the rest.

Control of the entire operation is centered in two houses on the north wall. Passage of vessels is controlled by two swinging miter gates, each of two leaves, leaves of the lower gate being 102 ft. high, weighing 525 tons each. Water flow is controlled by four 7x11½-ft. tainter valves, two for intake and two for discharge.

Operation of the valves and gates is interlocked to prevent damage, each being powered by a two-speed squirrel-cage motor. Each pair of intake and discharge valves operates in unison, start, stop and speed change of each pair being automatic and controlled from one switch. Miter gates are similarly controlled.

Testing continues

As the finishing touches are being given to the initial installation as here detailed interest centers on its forthcoming performance. Engineers look forward to seeing the characteristics of Kaplan turbines of such gigantic physical proportions in actual operation. How closely the prototypes approach the previous indications of their models will be watched.

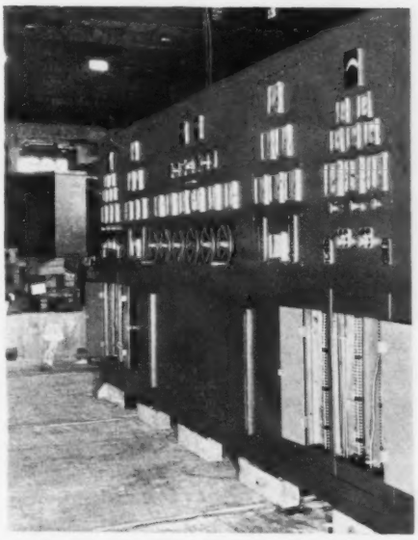
One item of more than ordinary interest will be the comparative efficiency of the two machines, for the blades of one turbine are machined to true theoretical shape, while those of the other machine are finished with the usual grind.

Improved Governor for Bonneville Turbines

By NORMAN NOLING
Woodward Governor Company, Rockford, Ill.

WHEN the electrical transmission system, whatever it may be as decided between the sovereign states of the Northwest and the federal government, is connected to the generators at Bonneville it will find those generators equipped with control and governing devices adequate within their inherent limits for the demands laid upon them. Before the development of sensitive and rapidly responsive governors, of which the Bonneville equipment is the very latest expression, maintenance of stability on a system including any significant amount of hydro generation was very difficult because of governor inability to control generator speeds within close limits during period of system disturbance.

In electrical system disturbances there are many factors wholly unrelated to the individual prime-mover governor that, however, do greatly affect its functioning. These factors may be in the characteristics of governors on other generators in the system or they may be conditions of an electrical or other nature; thus the direction of development in governor design has been toward what might be called controllable characteristics so that the individual governor may be adjusted according to what will be required of it for best performance in conjunction with the other elements of the electrical system. The advantages of controllable characteristics appear in highly developed form in the Bonneville governors most specifically in the inclusion of adjustable speed droop in their design. Thus it may be said that whatever may be the character and operating conditions of the electrical system to which the Bonneville plant will supply energy the governors will be readily adaptable to them.



Cabinet centralizes governor controls

Localization of all controls and indicators on the front of the actuator and pumping unit greatly facilitates operation. The front of the actuator cabinet is a control panel containing over seventy controls and indications pertinent to the proper operation of the two turbines. Within the cabinet, or connected to it hydraulically, electrically or mechanically, is the actual governing and auxiliary control mechanism.

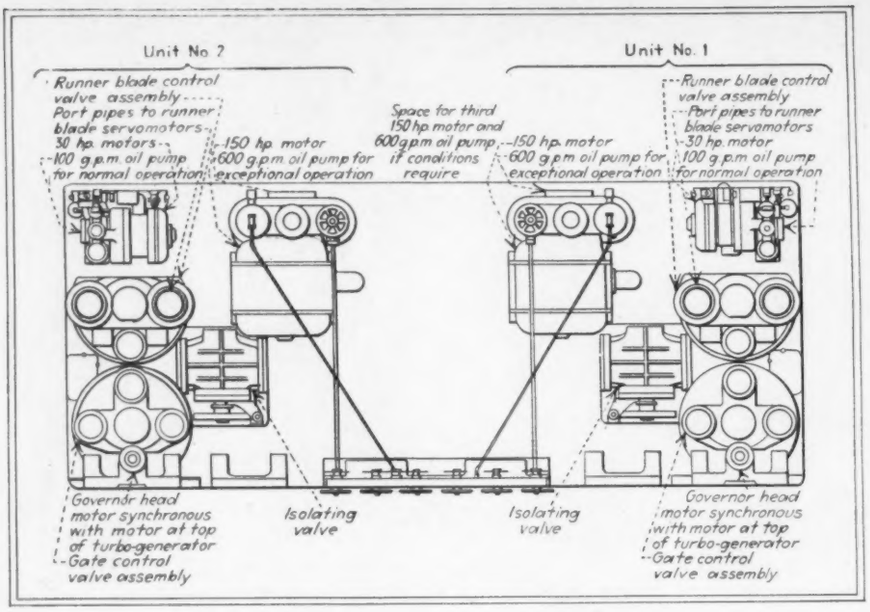
Most obviously noteworthy because it is the largest self-contained governing equipment in the world, the twin system cabinet actuator governor assembly now being installed in the Bonneville power house has numerous features more important and hardly less arresting than physical size.

The governor being the basic control mechanism in the operation of a waterwheel, it becomes logical to centralize all auxiliary controls and indications at the governor whenever consistent with plant design and proposed operating procedure. Such is the case at Bonneville.

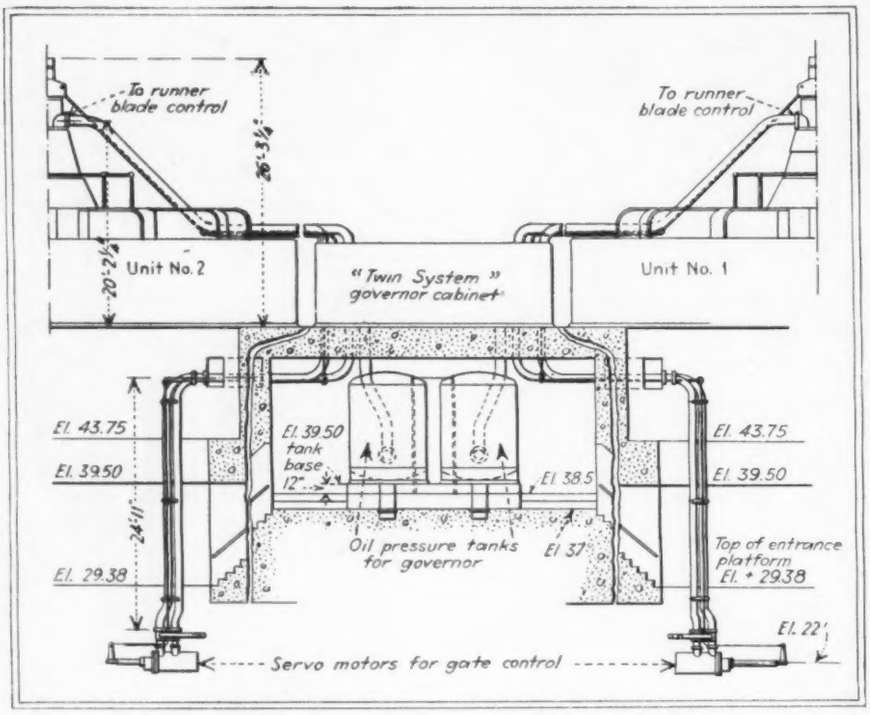
The basic function of a waterwheel governor is to maintain the speed of the wheel as nearly constant as possible by varying the flow of water through the wheel to suit the changes in load on the generator. The more closely the regulation of water flow can be made to follow the load changes the better the frequency regulation and stability of the electrical system will be.

In most recent hydro-electric installations of considerable size the electrical connection for driving the governor head has consisted of a small, permanent magnet, alternating-current generator directly driven by the shaft of the controlled machine and supplying current to a synchronous motor driving the governor head. In effect, there is a solid mechanical drive, unaffected by electrical disturbances, between the turbine and the governor head, and each speed change is immediately and accurately transmitted to the governor head. If the speed of the governor head departs from normal it moves a small pilot valve controlling the pressure oil flow, the relay valve is in turn operated and oil is admitted to the motors through the piping, and the resulting change in gate position and water flow returns the speed to normal. By means of the compensating connection, which is operated by the servomotor piston rod, the oil control valves are recentered when the necessary gate movement has taken place and are maintained in the central position as the speed of the governor head returns to normal.

The pressure oil for operating the servomotors is provided by motor-


Unit No. 2
Unit No. 1
Runner blade control valve assembly
Port pipes to runner blade servomotors
30 hp. motors
100 g.p.m. oil pump for normal operation
150 hp. motor
600 g.p.m. oil pump for exceptional operation
Space for third 150 hp. motor and 600 g.p.m. oil pump if conditions require
150 hp. motor
600 g.p.m. oil pump for exceptional operation
Runner blade control valve assembly
Port pipes to runner blade servomotors
30 hp. motor
100 g.p.m. oil pump for normal operation
Governor head motor synchronous with motor at top of turbo-generator
Gate control valve assembly
Isolating valve
Isolating valve
Governor head motor synchronous with motor at top of turbo-generator
Gate control valve assembly

Plan of Bonneville twin actuator governor assembly



Governor assembly between the two controlled units

Complete governing equipment for two 60,000-hp. turbines is inclosed in a welded steel cabinet 23 ft. long, 9 ft. 6 in. wide and 8 ft. high, located between the two units on the generator floor.

driven rotary gear pumps, and sufficient pressure oil to assure several servomotor strokes in rapid succession is maintained in welded steel pressure tanks conveniently located near the actuator and the servomotors.

The twin system cabinet type actuator consolidates the actuator, pumping unit, sump tank, pressure tank, piping and restores connections into a neat, compact and easily operated system. The resulting reduction in interconnecting oil piping and the number of pipe joints results in lower installation and maintenance costs. The relatively shorter length of fluctuating oil column reduces the regulating dead time or the time that elapses from the instant of a load change to the time of first movement of the gates.

In the Bonneville installation there are two identical governors for the two 60,000-hp. units, mounted on one base together with the pumping unit and inclosed in a single cabinet. The waterwheels are of the Kaplan adjustable-blade type with the runner blades, as well as the wicket gates, controlled by the governor. The twin actuator assembly, together with two Woodward permanent magnet generators for driving the governor head motors, two blade- and two gate-restoring connections, two sets of blade and two sets of gate servomotor port oil piping and four pressure tanks, comprises the complete governing equipment for the two turbines.

The welded steel base of the unit forms a sump tank large enough to hold all the oil used in the governing system. It is divided in half and provided with the necessary valves for isolating either half sump, pressure tank, relay valve or pumping unit without interfering with the operation of the rest of the equipment.

The normal system operating pressure is 300 lb. and two small pumps and two large pumps (with space provided for a third should operating experience indicate its advisability) are mounted on the base. The operating sequence is such that the two small pumps, driven by 30-hp. motors and delivering 100 gal. per minute, will furnish the oil required over periods of minor regulating demand, and the large pumps, driven by 150-hp. motors and delivering 600 gal. per minute, will cut in whenever the capacity of the small ones is exceeded.

Worthy of special mention among the many auxiliary devices included in the governing unit are the automatic net head level gate limitors and the intermittent generator brake applicators. While the normal operating head at Bonneville is 50 ft., it will be possible to get a maximum head of 69 ft., and at heads greater than 50 ft. it is necessary to limit the gate opening because the generators cannot absorb more than 66,000 hp. at 100 per cent power factor. This limiting action is automatically accomplished by means of the net head level gate limitors. The generator brake applicators are arranged to prevent application of the brakes until the turbine gates are completely closed and the generator breaker is open, after which the brake shoes are automatically applied intermittently until the turbine has stopped rotating.

June Income Up 8.9 per Cent

Increase over previous year is largest since October — Industrial energy sets third consecutive record — Other sales also rise

TOTALING $178,538,700 and exceeding last year's figure for the corresponding month by 8.9 per cent, the revenue of the electric power and light industry from ultimate consumers set a new record for June, executed an unusual up-turn compared with May and increased its lead over a year ago by the largest percentage since last October, according to statistics announced by the Edison Electric Institute. The energy generated amounted to 9,563,250,000 kw.-hr., or 12.4 per cent more than in June, 1936, and the daily average was the largest in the history of the industry, exceeding by a small margin the previous maximum, registered last December. A large portion of the increase came from water power, which rose 19 per cent over last year's June, while fuel-generated energy increased only 9 per cent. Purchases from other sources advanced sharply, gaining 76.2 per cent. A large portion of this increase was presumably due to Boulder Dam.

While sales to ultimate consumers of all classes were up 14.6 per cent, several groups showed considerably larger gains over a year ago. Sales to wholesale commercial customers were 16.5 per cent higher. In kilowatt-hours they increased for the fifth consecutive month, and for the third consecutive month they have established new all-time records.

The increase in domestic use was even larger, 17.3 per cent. Moreover, this item shows a rise, though a small one, compared with May. This is unusual. It points to a strong growth in the summer load, which has been gradually filling the seasonal valley and has advanced the beginning of the annual upward swing from September in 1929 to July in 1936 and now to June. A similar flattening of the summer valley is evident in retail commercial sales.

Comparing the twelve-month period ended June 30 with the preceding one, the average annual consumption per domestic customer increased 9.3 per cent to 762 kw.-hr., the average rate fell 6.6 per cent to 4.54 cents and the average monthly bill increased 2.1 per cent to $2.88.

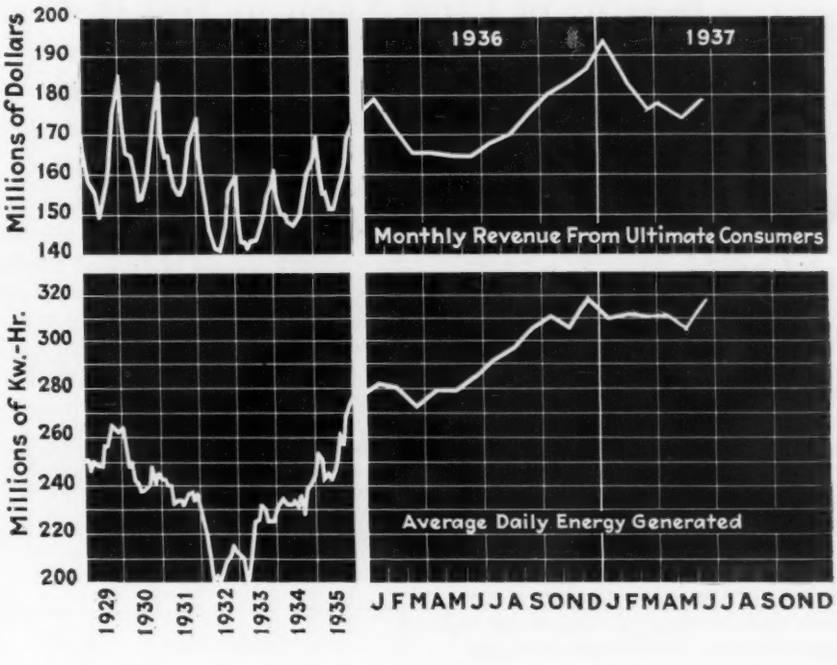


Table I—Monthly Revenue from Ultimate Consumers and Energy Output of the Electric Light and Power Industry

Compared with Corresponding Month of Previous Year

Month 1937	Revenue from Ultimate Consumers‡		Energy Generated, Millions of Kw.-Hr.*					
			Total		Hydro		Fuel	
	Thousands of Dollars	Per Cent Inc.	Gen.	Per Cent Inc.	Gen	Per Cent Inc.	Gen.	Per Cent Inc.
June	178,539	+8.9	9,563	+12.4	3,491	+19.0	6,072	+ 9.0
May	174,287	+6.3	9,459	+11.9	4,103	+15.5	5,356	+ 9.3
April	177,861	+7.3	9,335	+13.1	3,859	+ 6.0	5,476	+18.6
March	177,579	+7.2	9,664	+16.6	3,624	+ 5.1	6,040	+24.7

* By courtesy of Federal Power Commission, with deductions for certain plants not considered electric light and power enterprises. ‡ Edison Electric Institute.

Table II—Allocation of Energy by Classes of Service, 1937

Compared with Corresponding Month of Previous Year (Edison Electric Institute)

Class of Service	June		May		April	
	Millions of Kw.-Hr.	Per Cent Inc.	Millions of Kw.-Hr.	Per Cent Inc.	Millions of Kw.-Hr.	Per Cent Inc.
Total for distribution*	9,819	+13.6	9,703	+13.7	9,584	+15.0
Lost in transmission, etc	1,492	+ 8.4	1,589	+ 9.8	1,314	+ 3.7
Sold to ultimate consumers	8,327	+14.6	8,114	+14.5	8,270	+17.0
Domestic	1,342	+17.3	1,323	+13.6	1,418	+16.0
Com'l, small light and power	1,463	+14.8	1,399	+10.5	1,466	+14.5
Com'l, large light and power	4,889	+16.5	4,727	+18.9	4,672	+21.6
Municipal street lighting	136	−14.5	147	−18.4	162	−16.2
Railways — street, interurban	327	− 5.6	346	− 2.2	367	− 2.1
Railroads — electrified steam	98	+31.1	104	+34.5	111	+29.1
Municipal and miscellaneous	72	+ 5.3	68	+ 0.8	74	+ 5.5

* Generated, purchased from other sources, imported, less energy used in railway and other departments.

Quick Test Method for Instrument Transformers

Accuracy of Modern Watt-Hour Test Meters Restores the Benefits of Using Them to Test Instrument Transformers

By E. C. ANDERSON
Standardizing Laboratory, Alabama Power Company

WHEN Dr. P. G. Agnew of the Bureau of Standards proposed the two watt-hour meter method of comparing instrument transformers the meters lacked the accuracy of modern test meters. The time required for enough revolutions to insure accurate results was thus long enough to result in the adoption of less arduous methods. Also, the mathematical calculations necessary to transpose meter revolutions into transformer errors were quite complicated and consumed both time and mental effort. The result was that the method, while well known, was little used and soon gave way to less arduous ones.

This was unfortunate, as the meter method, while slow, had several advantages; namely, high accuracy (dependent upon that of the transformer used as a standard), minimum cost (as all necessary equipment could be found in the average meter shop) and simplicity of test procedure, the essentials of which were already familiar to the average meterman.

The two chief drawbacks mentioned above have been largely overcome in the modern modification of the meter method to be described. Modern test meters, with their far superior accuracy, reduce the number of revolutions necessary to a minimum required for accurate reading, and the use of a chart (Fig. 2) to read phase angle errors directly eliminates all tedious mathematical calculation, with consequent chances of error. The result is that no more time or mental effort is required to test a transformer this way than by any other contemporary method.

Testing a transformer is very simple. The equipment is connected as in Fig. 1. The ratio test at unity power factor is made first. Meters are run for a predetermined number of revolutions on the meter connected to transformer A (the standard) and stopped. The meter connected to B is then read and the reading corrected for that of A. For example:

Assuming that A made 10.02 revolutions and B 9.97, subtract 0.02 revolution from the reading of B and call its reading 9.95. Interchange the meters by means of the switches and run the same number of revolutions as before on the meter connected to A, which will be the one formerly connected to B. Read and correct meter B again and add the two readings for the total reading of transformer B. Then, the revolutions of A divided by the revolutions of B, and the answer, multiplied by one hundred, will be the per cent registration of A in terms of B, and this multiplied by the per cent ratio of A will be the per cent ratio of B.

The phase angle test is made the same as above, at 50 per cent lagging power factor, except that *the meters are started and stopped by the one connected to* B, and the per cent registration is that of B in terms of A.

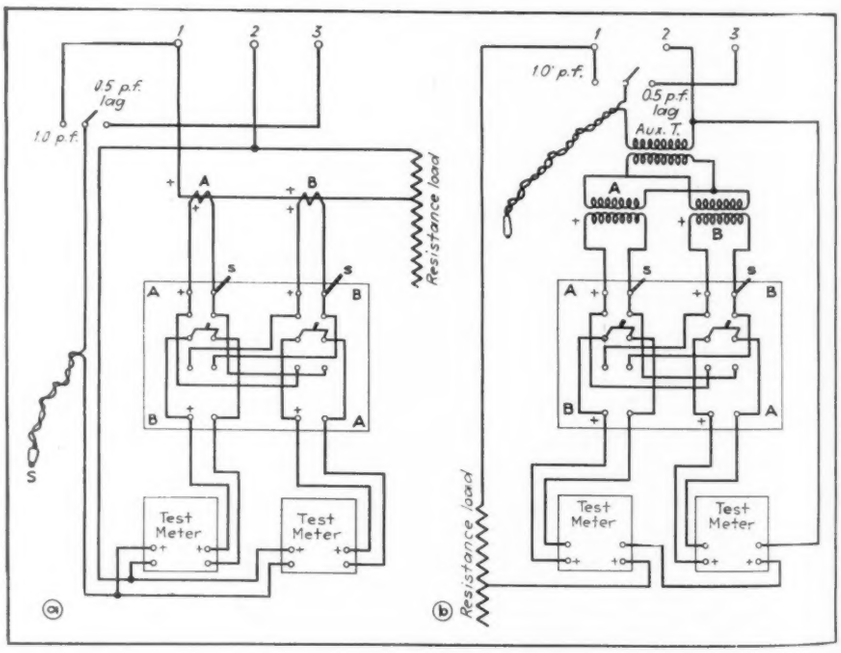


Fig. 1—Connections fundamentally identical for both current and power transformers.

(a) Current transformer test—Switches *s* and *s'* are used to short-circuit the C. T. during switch-over. Meters are started and stopped by snap-switch *S*. If loading is by means of phantom-load transformer a phase shifter will be needed as a potential source unless the phantom load transformer is known to have adequately high power factor. Any ammeter used to adjust the current must be removed or short-circuited during the test runs.

(b) Voltage transformer—Auxiliary transformer should be of 200 va. capacity and of same nominal ratio as those compared. Switches *s* and *s'* are *kept open during this test.* Any voltmeter used to adjust the test voltage should be cut out of the circuit during the test runs.

This per cent registration is then corrected for the per cent registration in the ratio check and the resulting phase angle factor used in conjunction with the known minutes of angle of A to find the minutes of angle of B from the chart.

While the above may sound complicated, it is really very simple in practice, and the per cent registrations of the two tests may be computed mentally, as in testing a watt-hour meter.

The following test of a voltage transformer will serve to clarify the details of testing and explain use of chart:

Assume that the corrections for the standard transformer A are 99.8 per cent on ratio and +10 minutes on phase angle. Also that the revolutions of transformer B are 39.8 at unity power factor and those of transformer A are 20.06 at 50% lag.

Then, testing for the per cent ratio of B at unity p.f.

Per cent registration of A in terms of B = Revs. of A × 100/Revs. of B = (20 + 20) × 100/ (20 + 19.8) or 40 × 100/39.8 = 100.5%

Per cent ratio of B = Per cent registration of A in terms of B × per cent ratio of A = $\frac{100.5 \times 99.8}{100} = 100.3\%$

At 50 per cent power factor lagging;

Per cent registration of B in terms of A = Revs. of B × 100/Revs. of A = (10 + 10) × 100/(10 + 10.06) or 20 × 100/20.06 = 99.7%

Phase angle factor = Per cent registration of B in terms of A at 50% p.f. × per cent registration of A in terms of B at 100% p.f.

$= \frac{100.5\% \times 99.7\%}{100} = 100.2\%$

Remembering that the minutes of angle of A are given as +10, with a phase angle factor of 100.2% the minutes of angle of B will be +6. To find this value, follow the dotted line on the chart down from +10 min. under the heading "minutes of angle of A" at the top, to the point where it meets the dotted line coming out from the right side corresponding to 100.2. Where these lines cross is six squares to the right of the diagonal line marked 0 min., and four squares to the left of the one marked +10 min. Therefore the minutes of angle corresponding to this position on the chart is +6 min., and this is the angle of transformer B. The use of a celluloid angle will be found very helpful in reading the chart quickly and accurately.

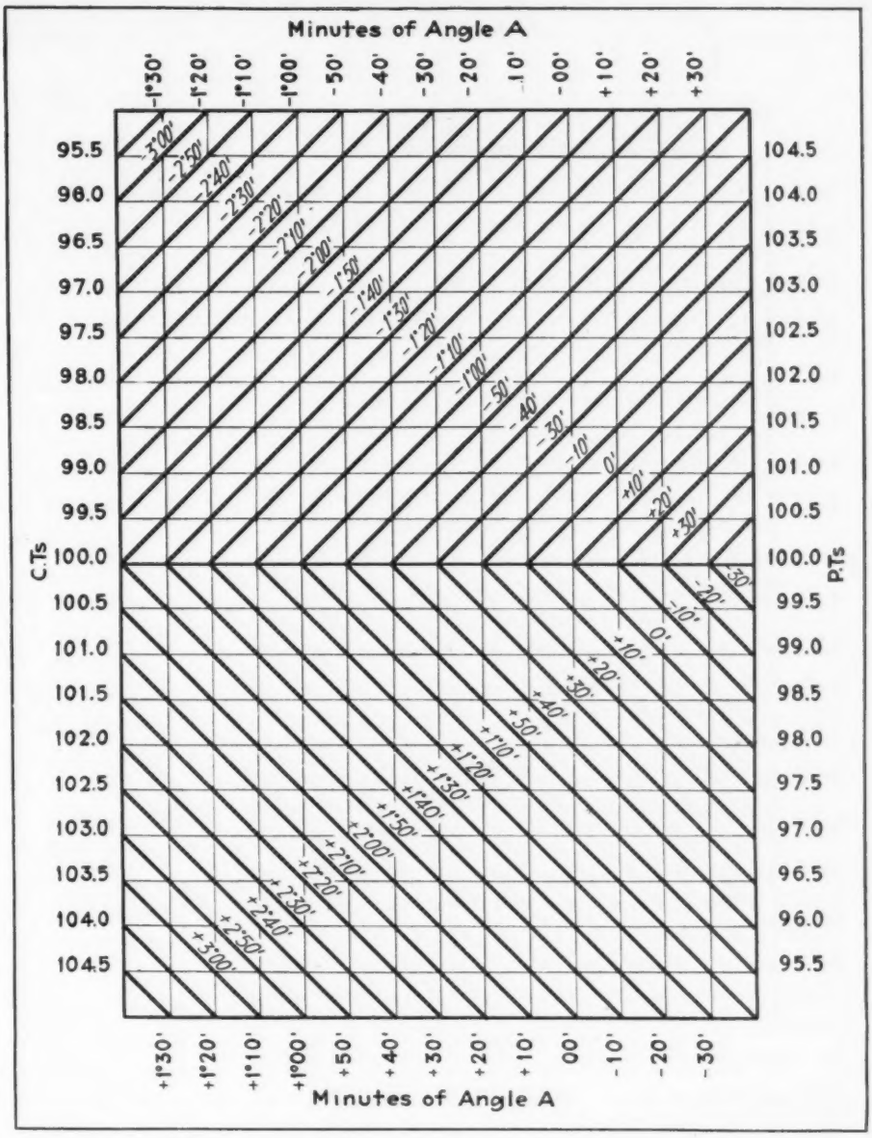


Fig. 2—Chart enables determination of phase angle of instrument transformers

When two transformers are compared at 50 per cent power factor the difference in reading between the meters will be proportional to the difference in phase angle and ratio in the transformers. Therefore, if the difference in reading is corrected for the difference in ratio, the result will be a quantity that will be proportional to the difference in angle between the two transformers. It can be proved that this value will be proportional to the cos $(\theta_2 + (a-b))/\cos \theta_2$, where θ_2 is the apparent angle in the standard transformer A at 50 per cent lagging power factor, and (a-b) is the angular difference between the angles a and b in transformers A and B. This angle, when found mathematically, may be subtracted algebraically from angle a to obtain angle b. All of these mathematical operations are done quickly and graphically on the chart, thus reducing to a minimum the mental labor with consequent chances of error. The minutes of angle of the standard transformer A are found at the top and bottom of the chart, and those of B, the transformer under test, on the diagonal lines that cross it. The values of cos $(\theta_2 + (a-b))/\cos \theta_2$, referred to below as the phase angle factor, are found at the sides, expressed in terms of per cent. Those on the right side are for voltage transformers and those on the left are for current transformers.

Vertical scales are revolution ratios determined in 50 per cent power factor test to ascertain the difference in phase angles of B and A (the reference instrument transformer).

Use right-hand scale for voltage transformers and left-hand for current transformers.

The connections for testing either potential transformers or current transformers are fundamentally identical. The test board *must* be marked as in Fig. 1, and best results will follow the practicing of a standard routine. In all tests, the 5-amp. coils of the test meters are the only ones used. If a loading transformer is used in testing current transformers some means must be found to compensate for its angle when testing at 50 per cent power factor, unless it is known to have a high power factor. This compensation may consist of a regular three-phase phase shifter, or a compensation tap may be taken off of two potential coils arranged in open V across a three-phase source. Assuming the coils to be connected in the form of an inverted V, with a phase sequence from left to right of 1-2-3, take the potential for the meters from leg 1 across to a point on coil 2-3 that will give exactly one-half reading on the wattmeter when the load is shifted from legs 1-2 to legs 1-3 for the phase angle test. This introduces an angle in the potential circuit to compensate for the one in the loading transformer. This adjustment, once made, is permanent and should be used for all tests with this transformer, either at unity or lagging power factors.

The number of revolutions to take

[*Continued on page 146*]

Editorials

Regulation Needed in Public Ownership

"The public should not imagine that a shift to public ownership and operation will relieve it of the task of working out a satisfactory program of utility regulation. A mayor with political ambitions may initiate a depreciation policy that will appear to make the operation of a municipal plan very successful during his administration. The most vital business problems of utilities are not solved by changing the form of ownership. Any fair test of the merits of either public or private ownership is dependent upon competent continuous regulation."

THIS statement, made by Prof. O. C. Ruggles in a 90-page survey just released by the Harvard Bureau of Business Research and entitled "Aspects of the Organization, Functions and Financing of State Public Utility Commissions," spikes one of the great fallacies prevalent today with respect to so-called non-profit public utility ownership. Municipal and government ownership advocates and promoters of rural co-operatives hold that where the service is not rendered for profit the necessity for state regulation not only does not exist but is a retarding factor. What the public does not understand is that the so-called profit motive takes many forms and exists under both private and government utility service.

The user is entitled to know what his utility services are costing him irrespective of the form of ownership. He is entitled to know whether public or private ownership costs less and which provides the better service, and having once made his choice he is entitled to have a fair and impartial regulation of the management of that service. Public ownership advocates forget that the service they are sponsoring is just as non-competitive as that sold by private interests. And therein lies the basis for utility regulation. Because the public needs the service and cannot secure it from some other source if dissatisfied with it or its cost, there must be some way to protect the public interest.

When in every state public bodies operating utility projects have to submit their operations to state regulatory commissions, in the same manner as privately owned utilities, the propaganda for public ownership on the part of political aspirants will subside. Then, if there be yardsticks, they will mean something other than bullying threats.

Telemetering and Totalizing Have Bright Future

THE more intimate operators of power systems can be with conditions at all points of their intricately interconnected lines, the more likely they are to conserve fuel and water, use equipment to best advantage, anticipate abnormalities and meet emergencies. It is perfectly logical to expect that new interconnections will be made at points where increasing loads are edging upward faster than capacities are being increased. This movement should, therefore, carry telemetering and totalizing along with it and thus provide operators with the continuous information they will need more than ever to be in full and composed command of their power meshes. It will if management accords them their proper opportunity in system operation.

Unfortunately management often looks upon telemetering as still in a gadgety state of evolution akin to television. Also, managers have a wholesome regard for the calm, intuitive sense of operators, so much so that they lag in appreciation of the fact that interconnection has rapidly outstripped the intuitive kind of system administration. But telemetering and totalizing need not so much to knock down these barriers as to have told in their behalf that knowledge of load and operating conditions can be worth many times what it costs to collect it.

Literature holds plenty of information on the technical side, but precious little on the economic merits of these companion developments as tools for system managers to provide for system operators. When executives are given such yardsticks to measure the tangible benefits against the outlay they will be more ready to leave the items for system information contributions on the budgets when put there by operators who know what they need but cannot always prove it on the ledger.

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Where Is TVA Heading?

WITH a bill for seven TVA's on the agenda for the next session of Congress, unusual attention is accorded the recent report of the Tennessee Public Utilities Commission, which approves construction of a steam plant for the Tennessee Electric Power Company on the grounds that the company could generate by steam cheaper than it could purchase from TVA. The commission's findings in this case immediately raise the question as to why more TVA's should receive consideration at the hands of Congress when it is found that a company located in the heart of the territory to be served by the present TVA can generate energy more economically than it can purchase it from the TVA.

A decision of this kind, based upon evidence sub-

mitted by well-qualified engineering authorities, casts a cloud over the TVA that will not be readily dispelled. Furthermore, the TVA picture is improved not a whit by the assertion a year ago of W. N. Carpenter, economist of the Edison Electric Institute, that for every kilowatt-hour sold by TVA the taxpayers of the nation contribute 1½ cents to keep TVA in operation.

More than that, the TVA books carry no item for depreciation, and as for taxes, TVA paid only $45,396 for the year ended June 30, 1936. With respect to interest, again the TVA books carry no charges, and these necessary fixed charges are borne by the taxpayer.

At present writing, therefore, TVA appears as a power-navigation-conservation conglomerate, reflecting on its books none of the regular fixed charges which burden operating companies, paying only a fraction of the taxes which would be assessed against a similar company owned by investors, apparently losing 1½ cents per kilowatt-hour on every one sold, and yet in spite of all these advantages it is found that a private company can generate power cheaper than it can buy it from TVA.

In the face of such devastating facts the taxpayer may well wonder just what he has derived from his $520,000,000 investment in the hills of Tennessee, with anywhere from $190,000,000 to $446,000,000 invested in power facilities. More than that, he cannot help but wonder on what economic grounds any more TVA's are worthy of serious consideration at the next congressional session.

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Water for Air Conditioning

IT IS ALREADY pretty well realized that a large-scale movement of air conditioning is going to tax electrical distribution facilities. But now a new problem arises in the matter of water supply for the installations. The Marketing Research Division of the Department of Commerce learns that in some thirty-eight of the ninety-two cities of 100,000 or more population steps have already been considered or taken to limit the use of water in conjunction with air conditioning. Limitations of both water supply and sewage disposal are back of the concern of municipal authorities. Many are already at or near the limit of their reservoir or pumping systems.

One of several things can and probably will happen. The popular appeal of air conditioning cannot be denied, and perhaps the cities will just have to expand their facilities and provide more water. Another possibility is the forced resort to water-cooling towers to reuse water and conserve it. A third eventuality is that systems of air conditioning which minimize the use of water will take precedence. One outcome not to be anticipated is that the march of air conditioning will be checked.

Somehow water is inescapable as an adjunct of electric power. In generation it necessitates huge quantities at hydro plants and comparably huge quantities for condensing at steam plants. Now the latest of utilizations also demands water in quantity. It is not at all outside the bounds of probability that water for fire fighting, water for air conditioning and water for all non-drinking purposes may conspire to make a dual water service system most advantageous for the cities. When that happens the electrical industry will benefit thrice—once in generating the power, once in selling the power and equipment for air conditioning and once in pumping electrically the general service water that need not be potably pure.

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Depreciation Rates for Steam Turbines

THE depreciation charge represents the annual decrease in value of machinery or buildings. While this is a factor in rate making, it also is an important consideration in the selection of new machinery. A longer working life for a certain machine, implying a lesser annual depreciation than one with shorter life, will in general justify the expenditure of more money to secure the improved efficiency of the unit with longer life.

It has been the accepted practice of many competent engineers to assume about twenty years as the operating life of a turbo-generator, and rates, efficiencies and first costs have been based on such an estimate of life. But in the superposed plant the older unit, which may have already been operated from fifteen to twenty years, is given a major overhaul and certain parts replaced, and is then expected to operate for another period—possibly twenty years—as the low-pressure portion of the new superpositioned plant.

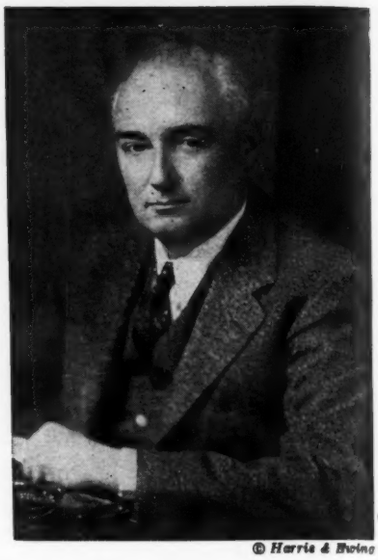
The question then arises in regard to the life of the new high-pressure superposed unit. Will its life be estimated as that of the remaining life of the low-pressure turbines? Or is it intended that the high-pressure units will also have, say, forty years of life? How do we know that it will be advisable to replace the older low-pressure units at the end of twenty years?

Quite aside from any questions regarding the physical ability of the older unit to operate for this increased period, it must be apparent that the wide adoption of superposition has brought in its train the necessity for a revision of formerly accepted axioms on depreciation.

On the other hand, the art of power generation is advancing, and if as great progress is made in the next twenty years as in the past twenty the depreciation factor can take almost any turn.

Two Significant Statements

By CARTER FIELD



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This noted journalist gives his personal comments and interpretations on current happenings affecting the electrical industry. His background and his location at Washington make his thoughts informative and interesting even though all may not agree with him.

TWO tremendously significant statements made by important figures since the adjournment of Congress should be studied by every official and security holder in the electric industry. One was made by Frank R. McNinch, chairman of the Federal Power Commission. The other was made by Patrick J. Boland, Democratic whip of the House of Representatives. The two statements are utterly unrelated, but they fit into a pattern the study of which may pay golden dividends to the utilities if its signs and portents are correctly read and result in action.

In brief, Mr. McNinch said that electric rates are too high, that enormous increases in consumption follow rate reductions, and that sales of power in the last year prove government competition has not laid the hand of death on the power industry.

Mr. Boland opined that the Norris seven TVAs (eight if you count enlargement of the function of the present TVA) bill would be shorn of its power features in the next session of Congress, and then passed.

Boland's statement shows that there *will* be a fight to protect the electric industry from nationalization. McNinch's statement shows the line of attack now being used by the other side. Significance of the statements is enhanced by the fact that right now is occurring probably the most important sounding out of public sentiment which has occurred since this country became independent.

Senators and representatives are finding out what the voters of their own states and districts think. It would be more accurate to say that they are trying to figure out what these voters will be thinking next summer and fall. What interests the legislators anxious to come back is the minorities who will switch from one side to the other if they become sufficiently excited about particular issues.

Now it is rather difficult to get an ordinary householder mad enough to bolt his party, or vote against his friends in a primary, because the government promises to push into his neighborhood with a government-operated electric system. He may be theoretically opposed to government ownership, and he may be an outraged taxpayer, but a promise that his electric bill will be reduced by this governmental action softens any tendency to erupt.

On the other hand, if the electric rates charged him by his privately operated company are reasonable—if he gets courteous treatment when he has a complaint—in short, if the local company has developed good public relations plus low prices—then there is more likelihood that as a taxpayer he may resent the New Deal power policy.

It is possible that he may talk so strongly on the subject to his congressman—or some scout of the senator—that those worthies may figure this government ownership issue is enough to swing that particular citizen in the primaries, or elections, or both. People are beginning to notice taxes. It is much more obvious than it was during the campaign a year ago. And there has been plenty of publicity for the certain fact that they are going to be boosted again.

Both McNinch and Boland are interesting figures in politics—worth watching. McNinch was a fairly successful politician in North Carolina until he angered the then Democratic boss of the state, Senator Furnifold Simmons. The senator retired McNinch to private life and kept him there. But when the Democrats nominated Al Smith for President, Simmons sulked. McNinch called on him humbly. Simmons encouraged McNinch to revolt, first secretly and then openly. Together they carried North Carolina for Hoover by an overwhelming majority.

But mark this. Of all the hundreds of key Democrats who bolted in the South in 1928, and who carried Virginia, North Carolina, Florida, Kentucky, Tennessee, Oklahoma and Texas, only McNinch seems to have profited politically. No other Hoovercrat has got to first base in the South since. Even Simmons was beaten for re-election on that issue. Apparently the voters were sore with the men who led them astray. And there was no gratitude at Washington.

Except for McNinch. That gentleman has something!

Pat Boland in 1930 was a Democrat in the hopelessly Republican district of which Scranton, Pa., is the center. He was wringing wet in a district where the political leaders, for reasons best known to themselves, figured it necessary to be dry. But so many soldier and miner friends told him they wanted to get rid of prohibition that, when he observed three arid Republicans contesting in their primary, he entered that as well as the Democratic, and won both! He has been reelected three times since.

Obviously, he now thinks *his* electorate is not enthusiastic about seven more TVAs. McNinch harps on cheaper electric rates and the wonderful opportunity for the industry, despite government competition. It's worth studying!

Letters TO THE EDITOR

Cost of Power in Manufacturing

To the Editor of ELECTRICAL WORLD:

In the ELECTRICAL WORLD of September 20, 1919, there is a chart or a tabulation giving the apportionment of manufacturing expenditures from a survey of 268,229 industries.

I am wondering if you have brought these data up to date. If not, can you give me the possible sources from which similar data may be compiled?

PAUL P. ASHWORTH,
Research Engineer
Utah Power & Light Co.

[The 1919 statistics were based on the Census of Manufactures for the year 1914. A more recent tabulation will be found in the ELECTRICAL WORLD of June 28, 1930, on page 1334, based on the Census of 1927. That tabulation shows, among other things, the cost of fuel and power, expressed as a ratio to value of product. It will be seen that this ratio is generally small, often negligible compared with labor, material and other costs.

A similar tabulation based on the Census of 1929 and giving the ratio by states rather than by industries was published in the ELECTRICAL WORLD of November 21, 1931, on page 923.

Fuller data for 1929, by industries, may be obtained from the report of the Census of Manufactures for 1929 by comparing figures on pages 37 and 161.

Those are the latest available figures. Reports were published for the census of 1931 and 1933, but they contain no statistics on power, fuel or energy. Reports for the Census of 1935 are now being issued in preliminary form, but they give no information on the subject under consideration.—EDITORS.]

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Venezuela Asks About Range Usage

To the Editor of ELECTRICAL WORLD

I was interested in the article on "Home Electrification," by H. N. Wells, on page 41 of the July 3 issue of ELECTRICAL WORLD.

It is difficult for the writer to see how Mr. Wells managed to cook for a family of four on an average of 78.6 hw.-hr. per month, using an 8,000-watt range. This would be on a basis of 2.6 kw.-hr. per day, or 0.87 kw.-hr. per meal, allowing three meals per day. The elements in an 8-kw. range are, I believe, 1,000 to 2,000 watts. Assuming two elements with a capacity of 3 kw. used on an average for the preparation of each meal and three-quarters of an hour as the time required, we have 2 kw.-hr. per meal or 6 kw.-hr. per day as a minimum, not counting the use of the oven.

I would be greatly interested to have an explanation of Mr. Wells' low figures.

L. ANCIAUX,
Venezuela Power Company, Ltd.
Barquisimeto, Venzuela, S. A.

Mr. Wells replied:

. . . The range is a Hotpoint, having three surface units of 1,200 watts each, one thrift cooker well with 200 watts and an oven which has two units with 1,500 watts each. Each unit and the oven has three stages.

I have talked with Mrs. Wells regarding reasons for the low consumption and her reasons given are as follows: Care in use of burners, turning them down or off as promptly as possible; use of a so-called "Dutch oven" on a surface unit instead of the oven when practical; use of the thrift cooker well; use of covered heavy utensils for cooking, and careful planning to bake or cook as many foods at one time as possible. Much current, she says, can be wasted by keeping the units on high or medium longer than is necessary. In boiling water or in cooking certain food they will continue to cook for some time after the current is turned off.

We have three meals a day, the heavy meal coming at noon. . . . . A roast is cooked once a week, which furnishes meat for two or three days, and the balance of the time we have fried or boiled meats. . . The oven is used freely for baking and for roasting.

I have just finished another year of checking and find we have used a little more current with the stove than last year. We are unable to account for the increase unless it is carelessness about reducing the current after cooking starts. Average per month for the second year was 92.5 kw.-hr., as against 78.6 the previous year.

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Another Amusing Stamp Situation

To the Editor of ELECTRICAL WORLD:

Your readers who are interested in power, in particular hydro-electric power, may wonder why, with all the hydro developments taking place in this country, we should use a picture of Canadian hydro power on our U. S. 25-cent stamp. If this means the beginning of a new policy on the part of our federal government, I see no reason why we should not use a picture of the new hydro power Great Britain is developing at Victoria Nyanza.

COLIN G. FINK,
Head Div. of Electrochemistry,
Columbia University, N. Y.

Better Room Cooler Design Needed

To the Editor of ELECTRICAL WORLD:

Knowing your interest in such matters, I am sending you a copy of a letter I have sent to numerous manufacturers of room coolers.

I believe the styling and size of these room coolers will be materially different in a few years particularly if they are to become very popular. The manufacturers overlook the attitude of women toward these devices in the home. For instance, if you should put a room cooler against a window for intake and discharge of air, how many designers of this equipment think of the curtains and how they should be disposed of, particularly if the cooler is to be taken out in the winter time. An intelligent woman studying this particular subject might be able to prepare for you an interesting article outlining the women's point of view.

E. W. LLOYD.
Vice-President Commonwealth Edison Company, Chicago, Ill.

Lloyd's Letter to Manufacturers

We think we are seriously handicapped in the sale of room coolers by the lack of styling of the containers. The present ugly oblong boxes do not impress the buyers and we are afraid they only purchase them because there appears to be nothing better on the market at the present time and they take what they can get because they want cooling.

We have on display in our shop some five or six makes, and while the sales are increasingly better, they are not nearly as large as we have a right to expect. At the present time these coolers are being placed in executives' offices, some small stores and the better homes. If your designers would visualize how the present unsightly coolers look in a fine modern office or a nice home, we are sure they would recognize the decided lack of harmony existing. When they are placed in a room in the home, they should conform to the design of furniture in the room. At the present time we are sorry to say this is not the case, and until some smart designer devises a container which does not clash with everything in a nice room we will not make the strides anticipated. While considering beauty of design you should also have in mind the size of the units. We frequently run across rooms where these coolers cannot be adapted to the room on account of their size.

Your observations on this subject would be a matter of a great deal of interest to us and after the present season we hope you will immediately take steps to improve the appearance of your product.

News OF THE WEEK

Power Output and Utility Revenues Reach New All-time Peak in Year

McNinch says industry enjoys prosperity — Asserts more building and less litigation would be "good business"— Points out that urgent problem is need for generating capacity to supply demand for energy

All of the federal and public and privately owned power projects now constructed or in the process of construction will not, in the opinion of Frank R. McNinch, chairman of the Federal Power Commission, be adequate to meet the demands for electricity within the next five years.

In a report showing that power production in the twelve months ended July 31 reached the unprecedented total of 117,994,000,000 kw.-hr., the commission pointed out that the power industry enjoyed the most prosperous year in its history.

More plants needed

"The concrete and urgent problem before the power industry today is, as I see it," Mr. McNinch said, "not whether it can sell all of the energy it can produce and earn a fair profit for the service rendered, but whether it has the foresight and imagination to build and build promptly and on a large scale more generating plants to supply the rapidly increasing demand." Mr. McNinch said that "more time spent in planning for construction and expansion and less in litigation and resistance to regulation would be good business."

Mr. McNinch expressed the hope that the power industry will do its full share toward keeping pace with the nation's power requirements. "Never again should there be such a calamitous power shortage as was experienced during the World War," he declared.

The commission's report showed that during the year ended July 31 power production was eleven billion kilowatt-hours more than in the preceding year and that during the first seven months this year output was nearly four and one-half billion kilowatt-hours more than in the same 1936 period.

Pointing out that the power industry enjoyed the most prosperous year in its history during the year ended July 31, Mr. McNinch said that the industry showed not only the greatest record of production and consumption but also of revenues for all time.

"This revelation of unparalleled growth and prosperity is the answer to those devotees of that ancient superstitution of hydromancy who gazed at the water of a few hydro plants the government was building and predicted the destruction of the private power industry," Mr. McNinch said.

Mr. McNinch predicted that output this year would be well over 120,000,000,000 kw.-hr. and that the 117,994,000,000 kw.-hr. for the year ended July 31 did not include energy produced by street and interurban railways, electrified steam railways and miscellaneous federal, state and other plants.

"It is both interesting and significant to note," Mr. McNinch said, "that as electric rates have gone down, production and consumption have gone up. It has been a shortsighted policy to keep electric rates 'as high as the traffic will bear.' Such false economy holds down the 'traffic' and hurts the power industry as well as the public. It has now been demonstrated beyond all cavil that the public wants and needs more and more power in industry, in commerce, in the home and on the farm. Only those who see through a glass darkly now fail to understand that the interests and prosperity of the power companies and of the consumers alike lie in the direction of electrifying America."

Mr. McNinch said that this can be done when electric service is furnished at such low cost as to make it available to the many millions who are now unable to afford this service. He said that during the past four years rate reductions have resulted in a saving to consumers of between $150,000,000 and $200,000,000. "I do not know of a single company which made any substantial reduction in its rates that has not been rewarded by an increase in revenue," he declared.

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Circuit Court Halts Utility Investigation

The Federal Power Commission was restrained by the United States Circuit Court of Appeals in Philadelphia this week from taking any further steps in its proposed investigation of the six Pennsylvania subsidiaries of the Associated Gas & Electric Company until the court decides whether the commission has the legal power to make the investigation.

Circuit Judge J. Warren Davis and John Biggs, Jr., set October 4 for argument on the jurisdiction of the commission to conduct the inquiry instigated by Gov. George H. Earle. It was the second time that the court had halted the inquiry started at the request of Governor Earle last March.

The companies involved included the Metropolitan Edison, Pennsylvania Electric, Erie Lighting, Clarion River Power, Northern Pennsylvania Power and Solar Electric Company.

State Bodies Are Warned Against Mounting Tax Burden on Utilities

Higher rates seen resulting from increase in levies — National Association of Utilities Commissioners sees lucrative field of taxation in assessing costs against industry — Mahood re-elected president

A warning against the mounting utility tax burden was sounded last week in Salt Lake City at the annual convention of the National Association of Railroad and Utilities Commissioners by Alexander M. Mahood of West Virginia, president of the association.

"In some states utilities have asked for permission to charge higher rates, just because of taxes," Mr. Mahood said, pointing to the social security, power sales and utility equipment taxes. He said that the mounting burden defeats its aim and hits the consumer.

Assess costs on utilities

The warning went unheeded as a report session resolution was adopted recommending uniform laws for assessing costs of regulating the utilities against the companies, which would add a still further burden on many companies.

The lucrativeness of this field of taxation was brought out in a survey of thirty-five commissions which revealed that while only a few commissions were financed by the assessment method, at least 50 per cent of the entire nation's revenue for carrying out public service duties were secured by that means. It was argued that the commissions are under-financed because the average commission expenditure is 21 cents for each $100 rate reduction saved the customers.

Carroll Miller, chairman of the Interstate Commerce Commission, declared that the original cost, or correct book value, was the equitable base for making utility rates. He said that when an individual invests in public utility stocks he should be warranted in expecting a fair return on his money, and not on an appraised value at any particular date, which may result in a return higher or lower than at the time of investment.

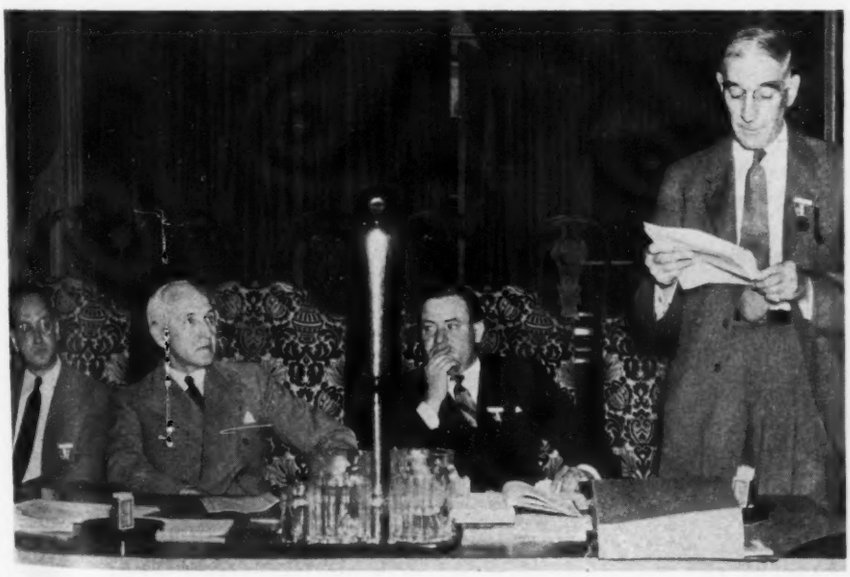
The fear expressed last year that the Federal Power Commission might absorb state powers was refuted by Robert Healy, chairman.

"We all know that state regulatory bodies have too often found themselves seriously handicapped, even balked, in their efforts to supervise local operating companies because they had no power over the parent-holding companies and little reliable information about them," Mr. Healy said. "They have found it difficult to regulate or even analyze important intercompany relationships. The holding company act was not intended to supplant state regulation, but supplement it by giving a federal agency jurisdiction over the uncontrolled holding companies."

Mr. Healy said that up to June 30 there had been registered under the securities act $4,000,000,000 of utility securities, setting forth the financial and operating records of the companies. He said that every utility having shares listed on exchanges had filed a similar report about its affairs. This information was offered to the state commissioners for their use by Mr. Healy.

Fred J. Schaaf of Washington, chairman of a special committee on rural electrification, urged that liberal rate and line extensions be encouraged. It was found that while rates varied greatly over the country as a whole, many being purely experimental from pressure and haste, there was a general tendency toward uniform rates with a minimum bill of $3 and $4. It was also found that the most successful projects toward rural electrification were those financed by utility companies with monthly guarantees.

The delegates chose New Orleans as the 1938 convention city.



COMMISSIONERS MEET—Carroll Miller, chairman of the Interstate Commerce Commission, speaking at the meeting last week of the National Association of Railroad and Utilities Commissioners. Left to right—Nelson Smith, New Hampshire; Gov. Henry H. Blood of Utah, Alexander M. Mahood of West Virginia, president of the association, and Mr. Miller

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Alabama Utility Signs Large Power Contract

A contract to supply 46,000 kw. capacity to the Tennessee Coal, Iron & Railway Company has been concluded by the Alabama Power Company, according to Thomas W. Martin, president of the utility. It is estimated that the Tennessee concern will purchase approximately 130,000,000 kw.-hr. a year.

The additional power will be supplied to the Tennessee company at its plants near Birmingham. Part of the power will be firm and part seasonal, Mr. Martin said.

The large steam-electric generating plants of the Tennessee concern have been for a number of years connected up with the Alabama Power system and power has been and will continue to be

exchanged between the two companies.

The additional supply of power is made necessary by reason of the fact that the Tennessee concern is installing a mill for the production of tinplate at Fairfield and to the increase in its rolling mill capacity and mining operations.

It is now estimated that the additional power will be required by the first of the year.

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Steam Plant Planned by Utility in Buffalo

A new $8,000,000 steam generating plant is to be constructed by the Buffalo Niagara Electric Corporation to take care of the rising demand for energy in that area, according to Col. William Kelly, president.

The new plant will house a single unit of 80,000 kw. and will be constructed in Buffalo Harbor, near Fuhrman Boulevard. It will have a rating of 1,200 lb. and 900 deg. F.

Colonel Kelly stated that options have been acquired for space for additional units as well as for coal storage. The coal will be delivered by boat. Construction on the new plant will begin in the near future and it is expected that it will be completed for operation by 1940.

While need for the additional capacity to the company's system is not immediate, it is anticipated that the completion of the new $12,500,000 plant of Chevrolet Motor Company and other industrial expansion projects in the Buffalo area will make it necessary to have added generating capacity in the future. The new plant will also relieve part of the load of the Huntley steam plant.

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President Appoints Seavey to Yellowstone River Board

Clyde L. Seavey, vice-chairman of the Federal Power Commission, has been appointed by President Roosevelt to represent the government in the Montana-Wyoming negotiations for division of Yellowstone River waters.

The commission to which Mr. Seavey has been appointed was authorized by a resolution of the last Congress to negotiate a compact providing for an equitable division and apportionment between the states of Wyoming and Montana of the water supply of the Yellowstone River and its tributaries.

Tennessee Electric Power Offers Plan to Solve TVA Power Problem

Guild says if government will make gift of 45 per cent of value of property utility will cut rates 10 per cent under TVA—Asserts federal program has been turned into campaign of sabotage

If the chief aim in the creation of the Tennessee Valley Authority is in cheap power the Tennessee Electric Power Company, in a public statement to the people of Chattanooga, proposes a method whereby electric rates will be 10 per cent under those now offered by the government power agency.

Jo C. Guild, Jr., president, stated that "if the federal government will make a gift to us of 45 per cent of the value of our property, and stop hamstringing us, we will make rates 10 per cent lower than TVA rates. On top of this," he said, "we will continue to pay taxes to city, county, state and federal taxing bodies. in the sum of more than $2,500,000 a year.

Way to get cheap power

"In other words," he said, "the various tax-collecting agencies will collect from us what will amount to more than 6 per cent on the money given us. If the people are really interested in cheap power, here's one sure way to get it. And it's fair to all —fair to the government, fair to the public, fair to the people who have invested their money in this business. And fair to our employees."

Mr. Guild pointed out that the PWA is now contributing 45 per cent of the cost of municipal power projects and that a gift of $2,000,000 is being offered Chattanooga so it can build a power system to compete with the utility. Mr. Guild asks: "If this venture is to be the profitable undertaking that some people tell you it will be, why a gift? Why can't the project stand on its own feet and be self-supporting? Is not this proposal of the government unjust and unfair? How long could the manfacturers of Chattanooga survive competition against such odds." Mr. Guild pointed out that this gift "comes out of all of our pockets in taxes."

Mr. Guild proposed the following to solve the power situation:

1. Creation of a power pool, as first outlined by President Roosevelt.
2. That Tennessee Electric Power, with other power companies of the Southeast, buy all of the TVA power not used by the TVA for flood control, navigation and governmental purposes. This power to be resold at rates fixed and regulated by the Federal Power Commission. Any savings effected by the TVA, through federal subsidies, to be passed on to consumers.
3. That TVA purchase Tennessee Electric Power as a whole, paying a fair value as determined either by negotiations or by any fair tribunal in condemnation proceedings.

Picture has changed

"But how the picture has changed!" Mr. Guild said. "Four years ago the federal government embarked on a program of so-called 'yardstick' power development, which has been turned into a campaign of sabotage to destroy the business of Tennessee Electric Power."

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Duquesne Light Lets Generator Contract

Duquesne Light Company has awarded a contract to the Westinghouse Electric & Manufacturing Company for a 60,000-kw. turbo-generator unit and auxiliary equipment for installation in the James H. Reed power station, where an expansion program is now in progress, to be completed late in 1938.

The utility has also placed an order with the Hagan Corporation, Pittsburgh, for complete automatic control equipment for two new high-pressure boiler units to be installed at the station, designed to develop a capacity of 375,000 lb. of steam per hour. An investment of close to $5,000,000 will be made in the new plant addition and equipment.

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Commission Cites Utility

Kentucky-Tennessee Light & Power Company has been ordered by the Tennessee Public Utilities Commission to show cause why its rates should not be reduced. Hearing has been set for September 14.

Federal District Court Upholds Santee-Cooper Hydro Power Plant

Judge Glenn refuses injunction against construction of $37,500,000 project — Says any damage utilities would suffer would be from competition — Asserts funds for South Carolina were earmarked

A permanent injunction against construction of the $37,500,000 Santee-Cooper River navigation and electric power project, sought by three power companies, was refused last week by Federal Judge J. Lyles Glenn of the Federal District Court at Columbia, S. C., on the grounds that the utilities "are not entitled to any injunction in any event."

Judge Glenn said in his opinion that "the court holds that the PWA statutes of the Emergency Relief Appropriations Act are not unconstitutional."

Long litigation

The decision came after long litigation by the South Carolina Electric & Gas Company, the Carolina Power & Light and the South Carolina Power Company against the State Public Service Authority and the Public Works Administration over the proposed construction of the development in the Santee Basin of Coastal South Carolina.

In his decision Judge Glenn said that "the court further holds, under the binding authority of the recent opinion of the Circuit Court of Appeals of the Fourth Circuit in the Greenwood County (Buzzard Roost) case, that the plaintiff companies are not entitled to an injunction in any event; that the damage which they will suffer is that arising purely from competition, and that this gives no right to equitable relief."

Commission powers upheld

In addition to denying the injunction, the decision of Judge Glenn held that the PWA statutes of the Emergency Relief Appropriation Act are not unconstitutional, a point which had been a main contention. It was also held that it was within the power of the Federal Power Commission to issue the license for the construction of the power project.

Last March 10, during the hearings, the utilities had contended that the power project would offer "injurious competition" to existing power plants; that diversion of the waters of a navigable stream (Santee River) was unlawful; that the loan the government would make through the PWA would be unsecured and illegal, and that the PWA was in effect "tampering" with intrastate power rates.

Funds earmarked

"On June 21, 1937, the United States Senate had under consideration an amendment to the Emergency Appropriation Act whereby Federal Emergency Administration of Public Works was continued. The sums of $16,650,000 as a grant and $14,850,000 as a loan were definitely earmarked for the Santee-Cooper project in South Carolina.

"It appears that on June 28, 1937, this allocation was agreed to by the Senate and has subsequently become the law.

"This is of importance as showing that the funds were earmarked for the completion of this project. This has a bearing on the plaintiff's contention of imminent danger. It also shows that the Congress has intention of completing this project."

Indications are that an appeal will be sought from the decision of Judge Glenn and that the case will find its way to the Supreme Court for final decision. There are now pending about 60 cases against PWA loans and grant for power projects.

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Fort Peck Project Too Small for $10,000 Administrator

Failure of the bill authorizing the creation of the position of administrator at the Fort Peck project was due to the belief that the proposed operation was not large enough to justify the employment of a $10,000 a year administrator, according to reports from Washington.

The bill which passed the Senate provides for a position of equal rank with that at Bonneville.

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Westinghouse Service Plant In Boston to Cost $400,000

Provided permission can be obtained from the Boston Zoning Board, the Westinghouse Electric & Manufacturing Company will build a new service plant and warehouse in South Boston for completion next spring at an estimated cost of about $400,000.

The structure will be roughly 350 ft. long x 176 ft. wide, with electrically

DISCUSS COMMISSION PROBLEMS—State utility commissioners from all parts of the country gathered last week at the four-day annual meeting of the National Association of Railroad and Utilities Commissioners held at Salt Lake City. It was one of the best attended conventions and many pressing problems concerning utility regulations were thoroughly discussed

welded steel framing and brick exterior, high-intensity lighting and complete modern appointments. A section for offices will require second-story construction on one part of the property.

The zoning board heard the company's petition this week. The Stone & Webster Engineering Corporation will be the supervising engineers on the project.

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Appeal on Trustee of Utilities Power

That the District Court of the United States for the Northern District of Illinois erred in entering an order appointing a trustee for the estate of the Utilities Power & Light Corporation on August 14 "in the absence of notice by publication to all creditors and stockholders as required by statute" is charged in a brief filed with the United States Circuit Court of Appeals by Utilities Power & Light, the Atlas Corporation and representatives of several protective committees.

In addition, the brief sets forth, the court was in error "since it was an abuse of discretion," as the court "already was in control of the assets and property of the debtor through four trustees," and since the appointment was made "over the objections of every substantial party in interest," and simply because the SEC insisted."

"The most serious error of all in appointing a trustee," the brief continued, "was the refusal to permit an offer made by Atlas Corporation, the principal creditor, to relieve the debtor from its financial embarrassment and permit the termination of the reorganization proceedings, to be submitted to the stockholders for their approval.

"Unless reversed, this action of the court will deprive the equity interests of at least $10,000,000. The petitioners have asked the Circuit Court for a stay of the appointment of a trustee pending the appeal.

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Hydro Cuts Electric Rates

General reduction of hydro rates which will mean an estimated $504,000 saving to Toronto citizens has been announced by the Toronto Hydro Power Commission. All classes of consumers will benefit, the commission stated.

Review of Decision on Utility Act Sought by Electric Bond & Share

Utilities see peril to all business in holding company statute—Brief filed last week states lower court erred in upholding registration provisions—Arguments are expected to be heard in October

An early adjudication of the Public Utility Holding Company Act, the legislation passed in 1935 and which has cast a cloud of uncertainty regarding the future operations of the utility industry, is seen in the move made last week by Electric Bond & Share and twenty-six affiliated companies seeking a review of the lower court in upholding the registration provisions of the act and declaring that the provisions are separable.

The brief was filed with the Circuit Court of Appeals and charged that the decision handed down by Federal Judge Julian W. Mack last January was in error. Judge Mack did not rule on the constitutionality of the act, but upheld the registration provisions. He also ruled that the act was separable as carrying out the intent of the Congress. The SEC instituted proceedings against the utilities in November, 1935, seeking to force registration.

Formula to control business

Stripped of confusing details, the requirement of the act is the exclusion of holding companies and their operating subsidiaries from normal and essential activities in interstate commerce unless they are under plenary control by the SEC, the brief charged.

"If this act should be sustained, there has been discovered a formula for the control of all business by the federal government; the prohibition of transactions in interstate commerce, and of the right to use the mails and facilities of commerce, unless such business submits to a control system which is beyond the power of Congress."

It was also charged that the SEC is empowered under the "death sentence" provision to reconstruct the public utility map of the United States as it will. This provision of the act was described as the "most arbitrary and vindictive provision which has been enacted into law since Reconstruction Days." The brief stated that the act will force Electric Bond & Share to dispose of its large foreign investments as a condition of retaining any of its domestic holdings.

The brief also charged that the penalty provisions of the act were attempts to coerce the utilities into registering and submitting to the will of the SEC.

Challenge entire act

If the "death sentence" provision is upheld, the brief stated, Electric Bond & Share, American Gas & Electric, American Power & Light and National Power & Light cannot continue to exist in their present form.

The utilities and the government joined hands last spring in an effort to "by-pass" the Circuit Court of Appeals, but the Supreme Court on June 1 denied the application of *certiorari.*

It is expected that the court will hear arguments early in October.

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More Cities Sign TVA Pacts

Announcement has been made by TVA of approval of power contracts with the cities of Trenton and Jackson, Tenn. This brings to a total of five the west Tennessee communities which have contracts providing for purchase of TVA energy for distribution over municipal systems at low resale rates.

Jackson has been purchasing power from the Authority for the past year for municipal purposes and the new contract provides for power for retail distribution. Trenton will be served over a 44,000-volt line from Jackson. Three other west Tennessee cities, Milan, Somerville and Bolivar, have been distributing energy from the Authority's river control dams for the past year.

•

Loup River Pole Contract

Loup River Public Power District, Columbus, Neb., C. B. Fricke, president, has awarded a contract for poles to the L. D. McFarland Company, Sandpoint, Idaho. The amount involved is $19,084.

Abundance of Power in Northwest Viewed by Engineers at Meeting

Boulder and Bonneville power prominent topics at A.I.E.E. meeting in Spokane—Agree success of Bonneville project depends on choice of administrator—Electric heating of residences also discussed

The influence of the impending power abundance in the Northwest and the existing abundance at Boulder Dam in the Southwest dominated discussions at the meeting of the American Institute of Electrical Engineers last week in Spokane.

It was agreed that the success of the Bonneville project will depend largely on the selection of an administrator. O. B. Coldwell, vice-president of Portland General Electric, said that his company hoped to co-ordinate its interests with those of the project. He declared that as a step in this direction his company was attempting, as rapidly as possible, to increase customer-use in order to offer the government something in the way of a load.

Mr. Coldwell predicted a gradual adjustment to the new source of power, eventuating in unified generation, co-ordinated transmission and local distribution over existing facilities.

After presenting his paper, "The Ultra-High-Speed Reclosing Expulsion Oil Circuit Breaker," A. C. Schwager, Pacific Electric Manufacturing Corporation, offered a suggestion in connection with the "Capacitance Control of Voltage Distribution in Multi-Breakers," presented for R. C. Van Sickle by P. B. Garrett, both of Westinghouse Electric & Manufacturing Company. Pointing out that the voltage gradient across any one pair of contacts is not uniform, but greatest near the contacts, he suggested the possibility of applying capacitance control to make the gradient across a single gap uniform, similar to the manner in which it is used to distribute voltage across several gaps.

ENGINEERS AT SPOKANE—The abundance of power in the Northwest occupied the interest of the 257 delegates to the Pacific Coast convention of the A.I.E.E. last week. Left to right, top—H. H. Henline, national secretary, and W. H. Harrison, national president. Below—C. E. Rogers, district vice-president, and Alvin E. Darland, field engineer at Grand Coulee. Left—Dean H. V. Carpenter, convention chairman, and Mr. Rogers

J. P. Jollyman, Pacific Gas & Electric, pointed out that for most lines reasonable corona probably does not offer interference to enough standard receivers to warrant undergoing the cost and mechanical difficulties incident to the use of special conductors for its reduction.

Results of studies by Dean H. V. Carpenter, State College of Washington, and Dr. C. E. Magnusson, University of Washington, on electric heating of residences were presented as envisioning the feasibility of mass use of electric space heating.

E. F. Pearson, chief engineer of Northwestern Electric Company, stated that recent studies by his company of a large, typical Portland residential area showed that to serve a diversified 12-kw.-per-home load would require a complete rebuilding of distribution facilities, representing for distribution alone a cost of 7 mills per kilowatt-hour. He said that for each customer the carrying charges on difference in equipment cost would approximate $50 a year. His company wanted the heating load, but considers the cost prohibitive to its general use.

•

Wins Fourth Franchise Vote

Iowa Southern Utilities Company was granted a 25-year franchise in a recent city election in Delta, Iowa, in which the vote was 219 for and 34 against the franchise. This was the fourth franchise election won by the company in Keokuk County and vicinity this year.

•

Approve Merger of Utilities

Stockholders of the Hudson County Gas Company and the Essex & Hudson Gas Company approved the plan to merge the two companies into the Public Service Electric & Gas Company, stockholders of which also approved the plan. The completion of the plan is subject to the New Jersey Public Utilities Commission and the Federal Power Commission.

•

Board Bars Utility Union

The Wisconsin labor board has denied the Union of Public Utility Employees, an independent organization composed of employees of the Milwaukee Electric Railway & Light Company, Milwaukee Gas Company and the Wisconsin Telephone Company, the right to be listed as an accredited labor union under the state's little Wagner act.

G. E. Joins Utilities in Electrical Plan

The General Electric Company, working with electrical utilities throughout the country, has announced the "Electrical Standard of Living" program and will contribute $60,000 in awards during the next year and a half as part of the plan, according to Carl M. Snyder, manager of the company's home bureau.

The program is to consist of a number of local activities, each sponsored by a local electric company in its own territory.

Participation by the public will be of two kinds. Those building or modernizing a home, work on which was begun after February 1, 1937, and which will be completed between August 15, 1937, and October 31, 1938, will be invited to submit plans, specifications and photographs to their local sponsor, which will judge the homes on the basis of ten specifications, including electrification, heating and air conditioning. Awards for the best entries will be made by the sponsoring utility, and in addition, General Electric will offer twenty prizes of $1,000 each for the homes selected nationally that best meet the ten specifications. Other interested manufacturers have indicated they will offer special prizes.

The second part of the program is educational in nature and open to the general public. It is also sponsored locally by utility companies, which will furnish participants with informative material detailing the advantages of complete home electrification and inviting them to describe briefly why electrical living appeals to them.

This activity will cover the ten-week period from September 27 to December 4. During each week General Electric will award ten $200 scrip prizes, applicable to the purchase of electric appliances and, finally, two fully equipped and electrified homes, costing $12,000 and $8,000 respectively.

•

Court Upholds Extra Pay

Judge Eugene Carter of Montgomery Circuit Court in a recent declaratory judgment held members of the Alabama Public Service Commission were entitled to $1,000 a year more than they now receive. Judge Carter ruled with the commissioners in their contention they should be paid the $1,000 extra compensation provided by statute for the enforcement of the 1931 Alabama motor carrier act. Judge Carter ruled the provision still was in effect. The commissioners asked that the pay be restored as of October 1, 1936.

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Sidney Hosmer Retires

Sidney Hosmer, vice-president and general manager of the Boston Edison Company, resigned his position as of September 2.

Meetings

Rocky Mountain Electrical League — Annual meeting, Estes Park, Colo., September 13-15. George Lewis, managing director, Gas and Electric Building, Denver, Colo.

Wisconsin Utilities Association—Transportation section convention, Lawsonia Hotel, Green Lake, Wis., September 13 and 14. Accounting section convention, same place, September 24 and 25. A. F. Herwig, executive secretary, 135 West Wells St., Milwaukee.

Empire State Gas and Electric Association — Annual meeting, Saranac Inn, Saranac, N. Y., September 16-17. George H. Smith, secretary, Grand Central Terminal, New York, N. Y.

American Transit Association — Annual convention, White Sulphur Springs, West Va., September 19-23.

Illuminating Engineering Society—Annual convention. Greenbrier Hotel, White Sulphur Springs, W. Va., September 27-30. A. D. Cameron, general secretary, 51 Madison Avenue, New York, N. Y.

International Association of Electrical Inspectors—Annual Meeting, eastern section, Hartford, Conn., September 27–30. Joseph P. Rohan, general chairman, Hartford Building Department, Hartford, Conn.

Iron and Steel Exposition—Sponsored by the Association of Iron and Steel Engineers, Stevens Hotel, Chicago, Ill., September 28-October 1. Brent Wiley, managing director, Empire Building, Pittsburgh, Pa.

Chicago Exposition of Power and Mechanical Engineering — International Ampitheatre, Chicago, Ill., October 4-9.

International Association of Electrical Leagues—Annual convention. New York, N. Y., October 6 and 7. O. C. Small, secretary, 155 East 44th St., New York.

American Institute of Electrical Engineers—Middle Eastern District, Akron, Ohio. October 13-15. H. H. Henline, National secretary, 33 West 39th St., New York, N. Y.

Electrochemical Society — Fall meeting, St. Louis, Mo., October 13-16. Colin G. Fink, secretary, Columbia University, New York, N. Y.

National Electrical Wholesalers Association — Semi-annual convention, Hotel Cleveland, Cleveland, Ohio, October 18–21. Alfred Byers, secretary, 165 Broadway, New York, N. Y.

National Electrical Manufacturers Association — Annual convention, Palmer House, Chicago, October 24-30. W. J. Donald, managing director, 155 East 44th St., New York, N. Y.

Chicago Power Show Nears Opening Date

Increased interest among exhibitors is reported for the Chicago Exposition of Power and Mechanical Engineering, to be held at the International Amphitheater, Chicago, October 4 to 9. Exhibits will demonstrate that power service costs can be cut and machine operations made more efficient by installing the most modern equipment.

Among the more than 120 leading manufacturers who have already engaged exhibit space are the following of particular interest to the electrical industry:

American Brass Company, Allen-Bradley Company, Breuer Electric Manufacturing Company, Bridgeport Brass Company, Carrier Corporation, Caterpillar Tractor Company, Coffing Hoist Company, Crane Company, Cutler-Hammer, Inc., Edward Valve & Manufacturing Company, General Electric Vapor Lamp Company, Jenkins Brothers, Johns-Manville, Jones & Laughlin Steel Corporation, Revere Copper & Brass Company, Ward-Leonard Electric Company, Westinghouse Electric & Manufacturing Company, Weston Electrical Instrument Company, Walworth Company, C. H. Wheeler Manufacturing Company.

Bird-Archer Company, Cleveland Worm & Gear Company, American Air Filter Company, Link-Belt Company, American Engineering Company, Modine Manufacturing Company, National Aluminate Company, Ramtite Company, Yarnall-Waring Company, Sarco Company, Plibrico Jointless Firebrick Company, Johnston & Jennings Company (Stowe Stoker Division), Wright Austin Company, Steel & Tubes, Inc., A. P. Green Fire Brick Company, Connery Construction Company.

•

Northwest Group Appoints Bureau and Committee Heads

Announcement has been made by Ralph E. Gale, chairman of the business development section of the Northwest Electric Light and Power Association, of the appointment of the following bureau and committee chairmen:

Industrial and commercial sales bureau, A. H. Wegner, Washington Water Power Company; residential sales bureau, Henry Kruse, Puget Sound Power & Light Company; rural sales bureau, W. Newmeyer, Portland General Electric Company; advertising committee, M. L. Cummings, Utah Power & Light Company.

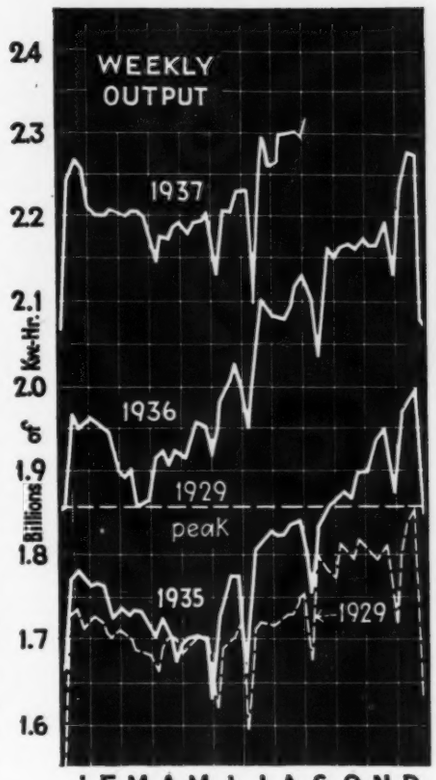
The industrial and commercial sales bureau will sponsor its third annual commercial cooking conference, probably in November. The annual meeting of the business development section in 1938 will be held in Medford, Ore., probably in March.

Output Resumes Rise

Energy production establishes new all-time record—Up 8.6 per cent over 1936

Jumping to 2,320,982,000 kw-hr. in the week ended September 4 and thereby surpassing the previous record attained only two weeks earlier by some 17,000,000 kw.-hr., the energy output of the electric light and power industry resumed its upward trend after resting on a plateau during the greater part of August, according to figures announced by the Edison Electric Institute. Operations a year ago were exceeded by 8.6 per cent. This was somewhat more than the gain in the preceding week, but approximately up to the average of the period since the middle of July.

In per cent increase over a year ago the lead continues to be held by the Rocky Mountain region, where the figures are running considerably larger than they were a few months ago. In the Middle Atlantic states the advance of 10 per cent was the largest since mid-July and an advance occurred also in the central West. Other regions show minor changes.



Weekly Output, Millions of Kw.-Hr.

1937		1936		1935	
Sept. 4	2,321	Aug. 29	2,136	Aug. 31	1,810
Aug. 28	2,295	Aug. 22	2,126	Aug. 24	1,840
Aug. 21	2,304	Aug. 15	2,094	Aug. 17	1,833
Aug. 14	2,301	Aug. 8	2,079	Aug. 10	1,819
Aug. 7	2,262	Aug. 1	2,079	Aug. 3	1,821
July 31	2,256	July 25	2,088	July 27	1,824
July 24	2,259	July 18	2,100	July 20	1,807

Per Cent Change from Previous Year

Region	Week Ending Sept. 4	Aug. 28	Aug. 21
New England	+ 6.7	+ 6.4	+ 5.3
Middle Atlantic	+10.0	+ 7.0	+ 6.8
Central Industrial	+11.0	+ 9.5	+12.3
West Central	+ 6.5	+ 1.4	+ 0.9
Southern States	+ 5.2	+ 5.1	+ 7.5
Rocky Mountain	+18.3	+18.4	+20.2
Pacific	+ 5.3	+ 7.6	+ 8.1
United States	+ 8.6	+ 8.0	+10.0

Need Seen for Early Bonneville Contracts

The power shortage which has developed in the Northwest, due to dry weather and the large demand of the government in the construction of the Fort Peck irrigation and power development, makes prompt negotiation of contracts at Bonneville desirable, according to Washington reports.

Negotiation of these contracts will be difficult, it is believed, for the reason that the private power companies are not greatly interested because the contract is limited to twenty years. Preferences are also given to public agencies.

It is believed that if they are awarded contracts construction of transmission facilities may be involved. The matter is complicated further by the fact that blocks of power must be reserved for the future use of public agencies.

As power will become available December 1 little time remains to arrange for its utilization, it is said. So far the administrator, who will negotiate the contracts, has not been named.

•

Payroll Above 1929 Figure

Payroll of the Warren Telechron Company of Ashland, Mass., has increased from 350 in 1929 to approximately 1,300 on the first of September this year, according to I. W. Kokins, vice-president.

•

$400,000 Plant Expenditure

Virginia Electric & Power Company is to expend approximately $400,000 in improvement of its equipment and plant at Reeves Avenue station in Norfolk. R. J. Throckmorton, vice-president, stated that details of the changes would be announced in the near future. Preliminary to the plant work, $79,950 has been authorized for five new steel transmission towers carrying high voltage from Newton Park to the Reeves Avenue plant and these are now being constructed.

•

Utility to Pay Dividends

Dividend arrears on the preferred stocks of Engineers Public Service Company will be paid by the first of the year as a result of action of directors this week. Dividends of $3.75 on the $5 preferred, $4.125 on the $5.50 preferred and $4.50 on the $6 preferred will be payable October 1 to stockholders of record September 20. Like amounts will be payable January 3 to stockholders of record December 10. These payments include arrears and regular quarterly dividends.

•

Blaw-Knox Makes Purchase

Blaw-Knox Company has purchased the assets and business of R. M. Gordon & Company, manfacturer of grease lubricating systems for steel industry, William P. Witherow, president of Blaw-Knox has announced.

•

New Prices for Westinghouse

Westinghouse Electric & Manufacturing Company has issued a new price sheet on HB coils, prices effective as of September 10, it was announced by S. F. Myers, manager of air-conditioning sales. It was said that all sizes of the Westinghouse air-conditioning units are now available with by-pass dampers. The by-pass units will not be furnished unless the same order on which the unit is ordered also includes an order for a Westinghouse evaporator or chilled water coil, it was said.

•

Bomb-Proof Power Station

Work has recently been commenced on the erection of a large electric power station at Stadsforsen, on the River Indalsalven, Sweden. The station, which will cost more than 20,000,000 kroner (approximately $5,500,000) is expected to be completed in 1940. A feature of the plant will be complete protection against attack by air, at least by any type of bombing airplane at present known.

Utility Stocks in Sharp Downward Move

A sharp break in the general market last Tuesday due to a war scare sent the "Electrical World" index of utility stock prices to 31.8 this week. Index previous week, 33.4; year ago, 39.2; 1937 high, 41.5; low, 30.6.

Associated Gas Unit Makes Stock Offering

The first campaign by a utility in many years to sell stock to consumers was undertaken this week by the New York State Electric & Gas Corporation, an affiliate of Associated Gas.

The company is offering 100,000 shares of $1.25 cumulative preferred stock at $25 a share, the proceeds to be used in financing a construction program to include considerable rural line extensions. The offering is limited entirely to residents of New York State and is being made without banking aid.

The New York State Public Service Commission has authorized the sale of the stock, and since it is limited to residents of the state, no registration statement has been made under the securities act to the SEC.

•

New Light and Power Issues Total $31,980,000 in August

During the month of August only one electric light and power company made a public offering of new securities. The Ohio Public Service Company issued first mortgage 4 per cent bonds to the amount of $28,900,000, serial notes totaling $1,600,000 and 16,000 shares of 5½ per cent cumulative preferred stock at $92.60 per share plus accrued dividends. Proceeds will be used to refund bonds, for additions and working capital.

The combined amount of these three issues, $31,980,000, representing the total of new electric light and power financing in August, compares with $43,472,635 for August, 1936. The eight-month period closed with a total of $537,467,394, compared with $844,835,463 for the similar period of 1936.

•

SEC Amends Rulings Under Utility Act

SEC has amended four of its rules under the Public Utility Holding Company Act of 1935, as follows:

Rule 9 C-3-(9), which provides an exemption from commission approval for certain types of acquisitions of securities, has been changed to extend a similar exemption in cases where securities are acquired incidentally in a reorganization of public utility companies of the same state, when all acquisitions of utility assets have been expressly authorized by the state commission.

Rule 17-C-4 was amended to permit registered holding companies or their subsidiaries, under certain circumstances, to have as their officers or directors representatives of owners of 10 per cent of outstanding voting securities, regardless of such representatives' financial connections. To complement this addition, Rule 17 C-6, limiting the number of directors and officers having financial connections, was extended to include this new category.

Rule 17 C-7, which permits registered holding companies or their subsidiaries under special circumstances to have as officers or directors persons with financial connections in institutions situated in territories served by the companies, was amended so that an officer or director of such companies may occupy a similar position in any subsidiary company even though the territory served by such subsidiary company does not meet the requirements set forth in the rule.

•

Dividend Arrears to Be Met

The board of directors of the West Texas Utilities Company has declared a dividend of 50 cents a share on the $6 preferred stock as a payment on the dividend accumulations in arrears on the stock. This dividend will be payable October 1 to stockholders of record at the close of business September 15. The board also declared a quarterly dividend of $1.50 per share on the $6 cumulative preferred stock, also payable October 1 to stockholders of record September 15.

•

Buying Rights Given to Emerson Holders

Common-stock holders of the Emerson Electric Manufacturing Company, Inc., of record May 5, 1937, have been given rights to subscribe to 80,000 additional shares of the company's new common stock at $9.37½ a share in the ratio of one share for each 3⅜ shares of new common stock held by them. Rights expired on September 9. The $750,000 of new capital obtained from the sale of this stock is to be used by the company to pay all arrears on its preferred stock and to improve its working capital position. The company's common stock was split 20 for 1 and the par value reduced to $4 in May of this year and there are at present 270,000 shares of new common outstanding.

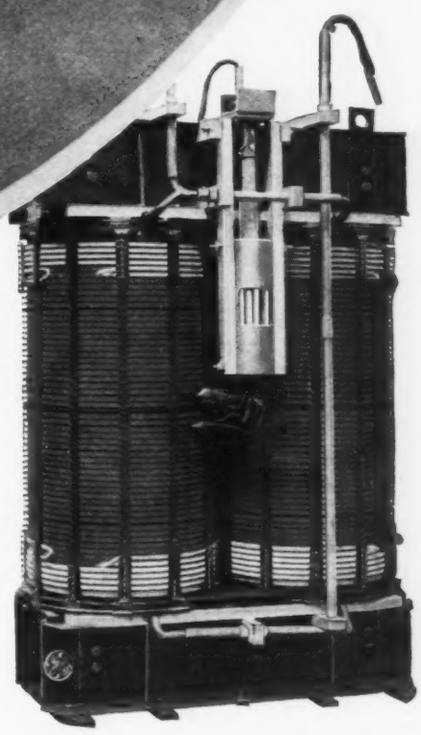
In his letter to stockholders L. G. Rowe, secretary, stated that during the past three fiscal years ended September 30, 1936 and the four months ended January 31 1937, the company has spent and capitalized $684,244 for additions to its manufacturing facilities.

Utilities Reports (Earnings)

	Net Income 1937	1936
* Nat. Pwr. & Lt. and subs.	$8,249,679	$6,631,405
‡* Assoc. G. & E. and subs.	35,586,080	34,990,253
† Amer. & For. Pwr. and subs.	6,417,996	3,476,161
* Eng. Pub. Service	3,392,970	2,668,401
* Kansas City Pwr. & Lt.	4,598,920	4,309,685
* Utah Pwr. & Lt. and subs.	1,695,879	1,009,612
* Montana Pwr. and subs.	4,074,459	2,791,891
* Florida Pwr. & Lt.	1,672,725	907,400
* New Orleans Pub. Serv.	980,189	366,055
§ Commonwealth Edison	8,677,639	5,870,495
† Louisville G. & E. and subs.	2,917,521	2,910,329
† North. States Pwr. (Minn.) and subs.	6,017,012	4,787,002

* Twelve months ended July 31.
† Twelve months ended June 30.
‡ Operating income (preliminary).
§ Seven months ended July 31.

MORE THAN 4,000,000 KVA WITHOUT A FAILURE



HOW best can you assure yourself of the reliability you should obtain from an investment as important as a power transformer?

By a comparison of factory tests? That helps, but reliability in power transformers cannot be demonstrated by test.

By an investigation of the integrity of the maker, the soundness of his engineering, the thoroughness of his laboratory research and supervision of materials, the superiority of his manufacturing facilities? Yes, that's further assurance because these things are the foundation of reliability.

By a study of service records alone? No, the element of chance is there.

But, when the theory is correct, the manufacturing is competent, and ***then*** the service record is perfect, you can have confidence in getting a reliable product.

The service record of G-E shielded-winding power transformers is outstanding. More than 4,000,000 kva have been in service through one to ten lightning seasons, and there has ***never*** been a failure of a shielded winding. General Electric Company, Schenectady, New York.

The effectiveness of the G-E shielding principle is matched only by its simplicity. Electrostatic shields, external to the windings, and connected to the line terminals, are so proportioned in each design as to provide the proper stress distribution. External application of the shields permits the retention of all the desirable features of G-E circular-coil construction, since there is no interference with the structure of the winding itself, or with the major insulation. Publication GES-1331 describes the G-E shielding principle. We shall be glad to send you a copy.

310-24

GENERAL ELECTRIC

GAIN CAPACITY

LOOK INTO THIS QUICK ECONOMICAL WAY OF ADDING FEEDER CAPACITY

MANY operating companies are taking advantage of Pyranol distribution capacitors to increase feeder capacity quickly and inexpensively. The field experience obtained by these companies proves the soundness of this practice. In a typical case, two 180-kva capacitors installed on a utility feeder gave the following results:

First, feeder current was decreased 50 amperes per phase, and voltage drop reduced 40 per cent.

Second, feeder capacity was increased by 500 kw, saving $28,000 over the alternative of installing another feeder.

Third, the savings in I^2R losses and in revenue due to correcting the voltage more than paid for the capacitors in the first year.

In short, the capacitors—shipped and installed quickly—gave immediate, satisfactory results. Make use of this low-cost method of adding kw capacity to your system, and save time and money. General Electric, Schenectady, N. Y.

General Electric, Dept. 6—201
Schenectady, N. Y.
Send me one copy of each of the bulletins checked.

- ☐ Application of distribution capacitors GEA-2509
- ☐ Class DPT capacitors GEA-2494
- ☐ Class ID capacitors GEA-2561

Name .....

Company .....

Address .....

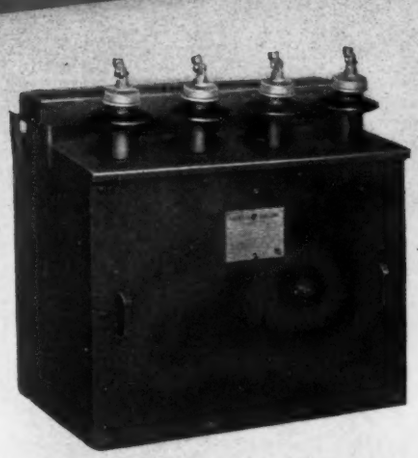
City ..... State .....

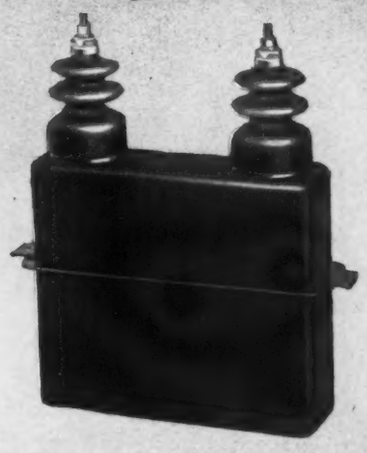
360-127

GENERAL

WITH CAPACITORS

. . . AND USE PYRANOL CAPACITORS





CLASS DPT HOUSED POLE-TYPE EQUIPMENT		CLASS ID INDIVIDUAL POLE-TYPE UNIT
30 to 180 kva, 1, 2, or 3 phase, 2300, 4000, and 4600 volts. Available in steps of 30 kva, three-phase and two-phase. Available in steps of 15 kva, single-phase.	**Ratings**	10 and 15 kva, single-phase, 2300 and 4000 volts. 15 kva, single-phase, 4600, 6900, 11,950 gr-Y volts.
Crossarm suspension.	**Mounting**	Single unit—on crossarm, or through-bolted to pole. Units in multiple—180 kva and below, three-phase—on double crossarm. Can be installed at transformer, utilizing existing cutouts and arresters.
Ventilated welded steel housings—strong, compact, dust-tight bus compartment.	**Housings**	Weatherproof welded cases drawn from heavy-gauge steel.

And the units in these equipments are treated and filled with noninflammable, nonexplosive Pyranol —which has made the General Electric capacitor service record 99.83% perfect.

L E L E C T R I C

Field OPERATING PRACTICES

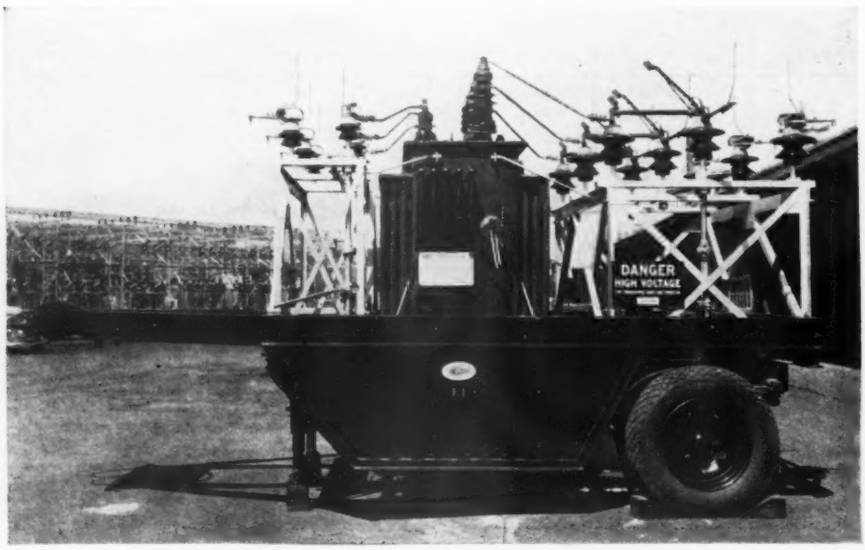
New ideas and practices in the operation of well-designed, constructed and maintained plants and systems

Portables "Pinch Hit" for Substations

Experience in meeting service emergencies of major importance has led the Connecticut Light & Power Company to concentrate three portable substations at its Waterbury service station, a point sufficiently central in the system to enable virtually any scene of trouble to be reached over the road within about two hours. The capacities of these fast-moving "subs" are 200, 500 and 1,000 kva. Each consists of a complete unit mounted on a detachable trailer and hauled by a heavy-duty traction truck, which is disconnected from the trailer unit after it is set up for operation. Each unit was designed to come within the limits of highway and overhead clearances (maximum heights of 500 and 1,000-kva. outfits are respectively 10 ft. 10 in. and 10 ft. 11 in.).

This compact design, including electrical switching mechanism and a transformer which can be used over a wide voltage range, facilitates rapid transport and setting up with only nominal loss of time at the scene of trouble. To facilitate reaching locations in minimum time, each emergency truck carries a highway route map and table giving exact road directions for traveling from Waterbury to the scene of service interruption, the distances from Waterbury to 56 base locations listed as centers, and the kva. capacity of transformer banks at these points. Thus, should trouble arise near New Preston, which has an existing bank of 500 kva. (3-phase unit), the portable substation would travel by Route 73 to Watertown, U. S. 6 to Woodbury, Route 61 to Morris, Route 109 to Bantam Falls and Route 25 to New Preston.

Upon arrival the portable "sub" can be connected almost within a matter of minutes under many situations as a "plug-in" unit, and with the rear wheels blocked and front end of the chassis supported by drop legs, the tractor truck pulls away for other service.



1,000-kva. portable substation on trailer ready for emergency service run

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Sleet Melting by Niagara-Hudson Co.

By L. J. AUDLIN
Relay Supervisor Central Division, Niagara Hudson Power Corporation, Syracuse, N. Y.

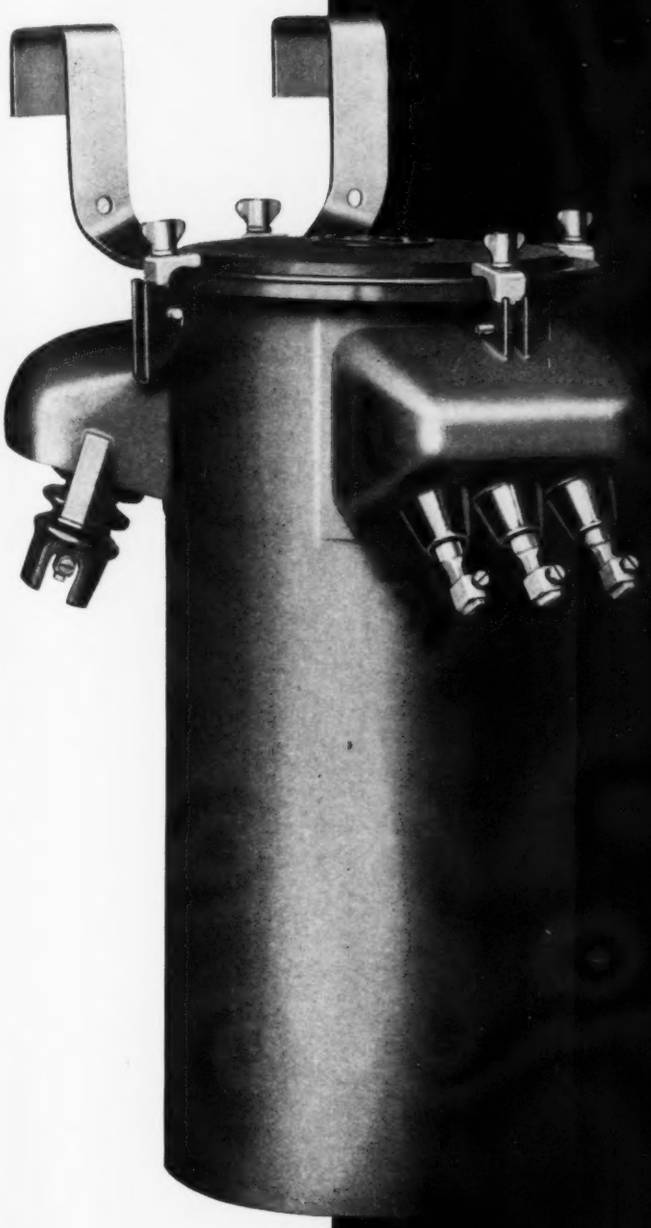
During 1931 it was decided to devise methods for melting sleet on the 110-kv., 60-cycle transmission lines in the central division of the Niagara Hudson System. After a careful study was made of the various power transformers and transmission line characteristics, it was decided to use the power transformer banks at some of the larger substations as a source of current for melting sleet off the conductors.

There are two 15,000-kva. transformer banks stepping down from 110,000 to 44,000 volts at Deerfield substation near Utica, N.Y. The three double-circuit lines radiating out of this station to Oneida, Boonville and Inghams are 22, 27 and 25 miles long, respectively.

By using the proper voltage tap on the 44-kv. side of these banks and applying approximately 44,000 volts to the circuits, it was found that approximately 600 amp. would be obtained if one end of the double circuit were connected to the source of power, the two ends jumpered together at the next station and the short circuit placed on the other line at the Deerfield end.

By paralleling the double circuits mentioned above it is possible to melt sleet from circuits beyond Oneida,

L-M DISTRIBUTION TRANSFORMERS



FOR DEPENDABLE SERVICE TO YOUR CUSTOMERS . . .

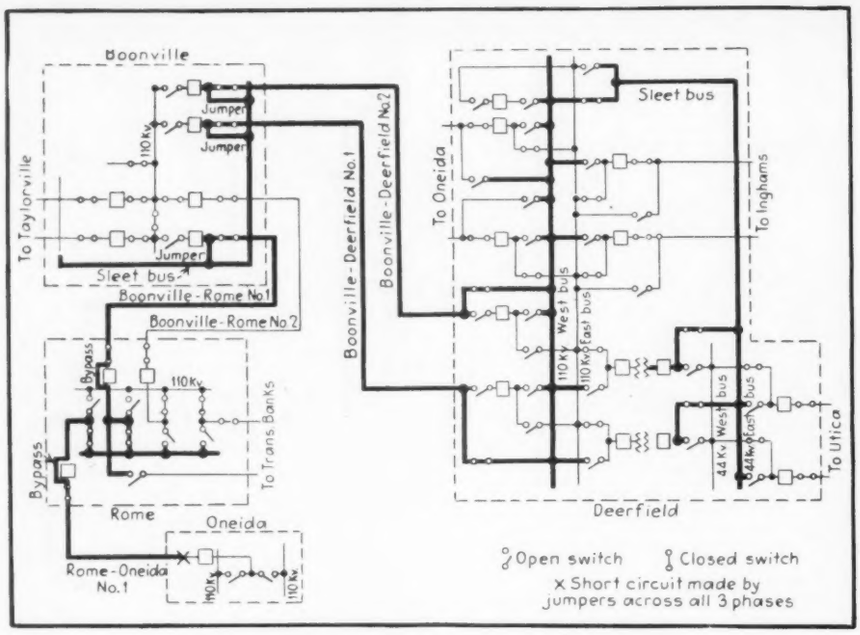
Exacting tests and scientific research have produced refinements in L-M Transformers that provide trouble-free operation, with greater safety to line men, easier installation, lasting life.

You can specify L-M Distribution Transformers with full confidence of absolute dependability and minimum maintenance cost There is a single phase type available for every installation—up to 200 KV-a, 13,200 V.

For complete information see your Line Material Co. representative, or write to South Milwaukee, Wisconsin.

LINE MATERIAL CO.

DISTRIBUTION TRANSFORMERS—FUSE CUT OUTS—
LIGHTNING ARRESTERS—HIGH TENSION EQUIPMENT—
FIBRE CONDUIT—STREET LIGHTING EQUIPMENT—
POLE LINE HARDWARE—LINE CONSTRUCTION MATERIAL



Sleet melting on Rome-Oneida No. 1 circuit

Sources of power on transformer banks 1 and 2 at Deerfield, two Boonville-Deerfield lines are operated in parallel and short-circuit jumpers are shown located at Oneida

Boonville or Inghams. The attached sketch indicates how sleet would be melted off Rome-Oneida No. 1 circuit. The short circuit would be placed on this circuit at Oneida. Rome-Oneida No. 1 would then be connected in series with either Boonville-Rome No. 1 or No. 2 and in series with Boonville-Deerfield No. 1 and No. 2 in parallel.

Sleet buses are made up where necessary and with the use of power transformers at various stations it is possible to melt sleet from any 110-kv. circuit in the central division.

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To Reduce Welding Fires

Suggestions for fire prevention through the safer use of portable cutting and welding equipment have been issued by the inspection department of the Associated Factory Mutual Fire Insurance Companies, Boston. In a group of plants analyzed fires from this cause have increased at a rate 45 per cent above 1936 and 64 per cent above 1935 so far this year, and in the last nine years 591 such fires have caused a total loss of $652,000. The chief danger appears to be in the use of such equipment in unsafe locations, or without proper precautions. Many operators fail to realize that sparks or globules of hot metal can, and often do, ignite combustible material at distances of 35 ft. and over. The suggested remedy is to forbid the use of cutting or welding equipment unless the location has been inspected and approved by a responsible authority, and nine major points are covered:

1. Appoint a competent supervisor with authority to establish and enforce suitable precautions, allowing work only under a signed permit, in designated areas and by experienced operators. Insist on precautions by outside contractors as well as by employees.

2. Always keep automatic sprinklers in service during cutting and welding.

3. Use no cutting and welding equipment in unsprinkled combustible buildings, or where floors and partitions are not tight. Sweep down floors and wet down wooden floors or cover them with sheet metal or equivalent. Prevent sparks from outdoor work entering building openings.

4. Before starting work, remove any combustible material at least 35 ft., or protect by asbestos or sheet metal curtains or guards. Shut down processes exposing combustible fibers or materials. Remove dust deposits which might be exposed to sparks.

5. Do not permit cutting or welding near flammable liquids or combustible vapors or gases. Thoroughly ventilate locations where such liquids or vapors have been present.

6. Do not work on closed containers which may have held flammable or combustible materials. A film of such material on metal surfaces may produce explosive vapors when heated. Purging with air, steam or flooding with water is sometimes effective.

7. Do not do cutting or welding on ducts unless sure these are clean and free from combustible deposits.

8. Watch for sparks and drops of hot metal by using extra men with fire extinguishing equipment, observing cracks, openings, curtains, guards and floor conditions, for at least 30 minutes after operations.

9. Keep all equipment in good condition, using according to maker's instructions.

•

Arc Welding Fills in Steam Cuts

An illustration of the practical value of electric welding as a power plant maintenance tool is shown in the accompanying illustration. The part shown is the steel casting on the packing water runner of a turbine in a large Great Lakes power plant. The face of the casting was badly steam cut. It would cost $917 to replace the casting. The part was successfully repaired by electric welding at a small fraction of the replacement cost. The worn face was chipped clean and the original dimension restored by appli-

Lincoln Electric Company

Turbine packing runner repaired by welding

TIME CANNOT ALTER STRUCTURE . . . *another high spot in*

TODAY'S TREND TOWARD PYREX POWER INSULATORS

PYREX is a Trade Mark and indicates manufacture by Corning Glass Works, Corning, N. Y.

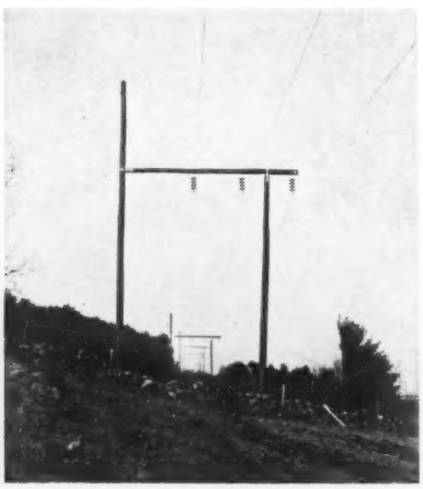
cation of new steel by the electric arc process. Material welded ranged between $\frac{3}{4}$ and $\frac{1}{8}$ in. in thickness. The work required only four hours.

•

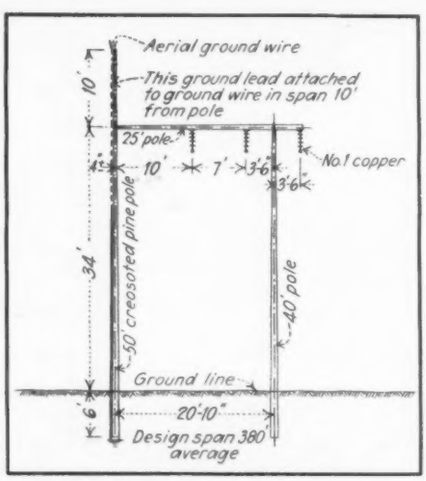
Wooden Poles for Crossarm Service

To secure maximum protection against lightning on the New England Power system's 22-kv. line recently built between Spencer and Charlton City, Mass., a somewhat novel use of wooden poles for crossarm service was developed by the engineering department of the New England Power Engineering Service Company. The design is known as the company's "Polarm" structure.

In a typical structure designed for ultimate service at 66 kv., with a 380-ft. span and present use of No. 1 copper power conductors, a 25-ft. creosoted pole supports the suspension disk insulators as shown.



Polarm structure on longitudinal span



Elevation of polarm structure

giving a horizontal separation between conductors of 7 ft. and a minimum spacing of over 10 ft. between the nearest conductor and the drop lead from the overhead ground wire. The crossarm pole is attached to the two vertical poles by Ohio Brass pole fittings, one upright being 40 ft. and the other 50 ft. long. The wood insulation level is maintained at guy locations by the insertion of wooden guy strain insulators of sufficient length to supply any deficiency. It is estimated that the effective insulation of the line against lightning strokes is about double that of the former lines of the system used at this operating voltage (22 kv.).

•

Rules for Pole Installation

The Detroit Edison Company uses the following rules for installation of poles, based on many years of experience in the particular territory:

Storage—When poles must be left lying on the ground longer than two weeks they shall be supported and maintained at least 12 in. above the level of the ground.

Facing—Poles shall be set with the greatest curvature in the direction of the line. In straight line construction of uniform span, adjacent poles shall be set face to face or back to back (the face is the side carrying the crossarm). When spans are unequal or there is any chance for unequal strain poles shall be so set that the crossarms will be on the side away from the maximum strain. At minor angles (0 to 60 deg.) in a lead, poles shall be faced so that the crossarms will bisect the angle formed between the wires. Poles set at T-corners shall be faced so that the double arms for a stem lead will be below the arms for the cross lead. Two poles placed for transformer platform shall be set face to face.

Raking—All 22-ft. or 25-ft. wood stubs and steel stubs shall be set with a rake of approximately 18 in. from center line at ground to center line at the top, unless otherwise ordered. Longer stubs, poles used as stubs and poles at flexible deadends should be raked only enough so that they will be practically vertical whe normal loading (at stringing tension) is applied. A pole whose butt is offset at a T-alley corner shall be raked about 15 in. so that its top will be in both leads after normal loading is applied. Additional raking will usually be necessary in such a pole to compensate for the bending caused by line tension.

The following table shows the amount of rake on poles to be used ordinarily. These values may be varied to suit field conditions:

Height of Pole or Stub	Rake in Inches*
30 ft.	18
35 ft. (Classes 4, 5, 6 and 7)	30
40 ft. (Classes 1 and 2)	30
40 ft. (Other classes)	36
45 ft. (Classes 1 and 2)	36
45 ft. (Other classes)	48
50 ft. (Classes 1 and 2)	48
50 ft. (Other classes)	60
55 ft. (Classes 1 and 2)	60
55 ft. (Other classes)	72

* Computed on basis of a loading equal to ½ ultimate strength of poles.

Depth of Setting—Poles shall be set in the ground to depth called for in the following tables:

Length of Poles	Depth in Ground
21½ ft. steel stub	5.0 ft.
22-40 ft. wood pole or stub *	6.0 ft.
45 ft. wood pole	6.5 ft.
50 ft. wood pole	7.0 ft.
55 ft. wood pole	7.5 ft.
60 ft. wood pole	8.0 ft.
65 ft. wood pole	8.5 ft.
70 ft. wood pole	9.0 ft.

* 30-ft. pole may be set 5.5 ft. if needed for clearance

Poles may be set deeper if necessary for foundation strength, but butt-treated poles shall not be set so deep that the top of the treated portion is less than 6 inches above the ground.

When poles are set beside a ditch the depth of setting shall be measured from the lowest ground surface in the general direction of the load, within four feet of the center of the hole.

Backfilling—In general, when a pole is being set the hole shall be backfilled with the same earth which was removed from the hole. The earth shall be thoroughly tamped for the full depth of the hole. In special cases, such as in marsh or on edges of streams, it may be necessary to use cribbing or ballast.

Concrete—(1) *General* — No concreting shall be done when the temperature is below 15° F. Concreting of sidewalks and pavements shall not be done in freezing weather, and preferably concreting of pole foundations shall not be done during freezing weather.

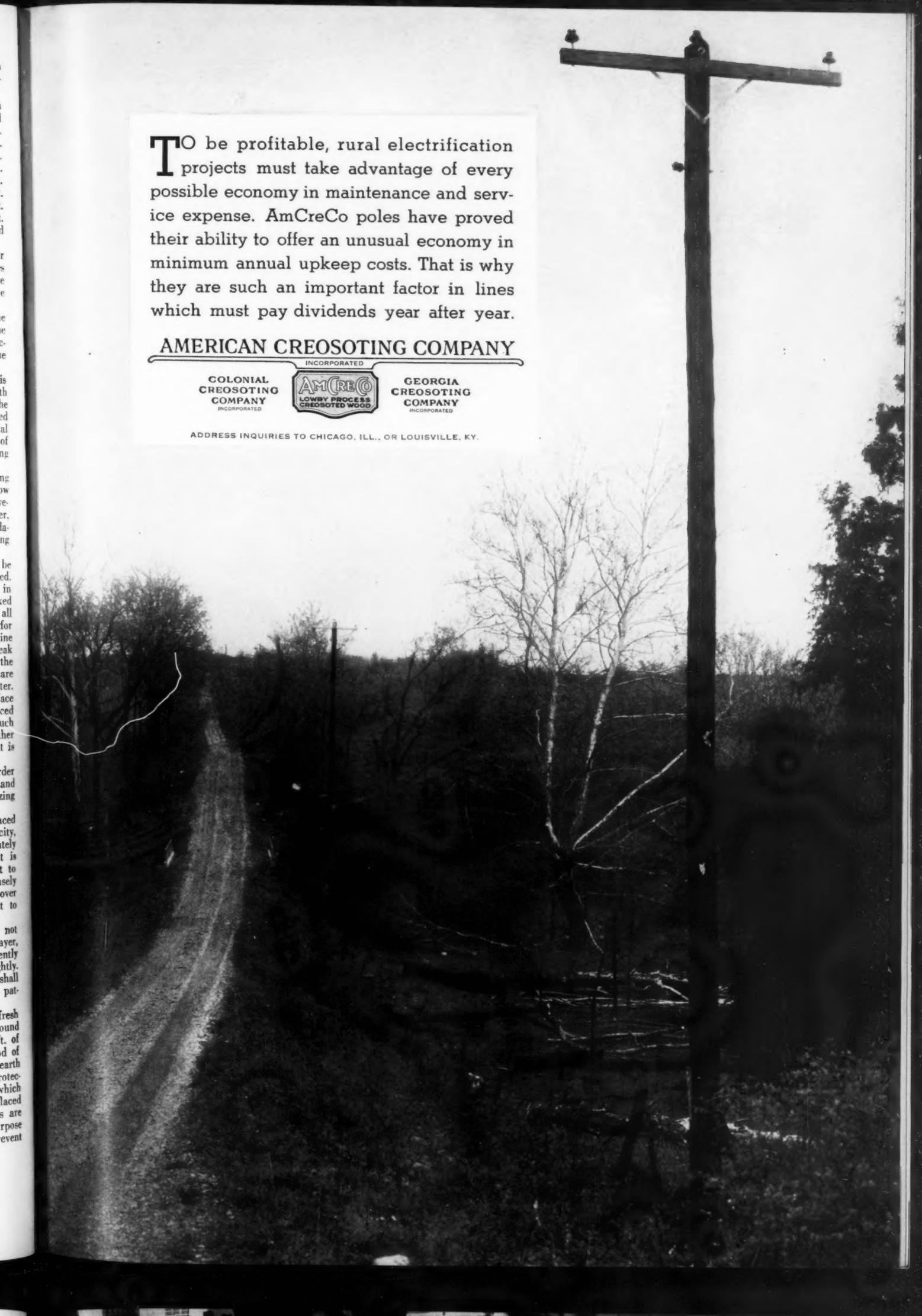
(2) *Mix*—Cement and gravel shall be thoroughly mixed before any water is added. Water shall be clean and shall be added in sufficiently small amounts and well mixed each time. Mixing shall continue, after all the material has been added to the mix, for at least three minutes, whether by machine or by hand. Too much water makes weak concrete. The final mixture shall have the consistency of dry, stiff paste. Extreme care shall be used not to add too much water. When free water accumulates on the surface of a concrete mass after the mass is placed and tamped, this is evidence that too much water has been used. In freezing weather warm, but not extremely hot, water as it is convenient to obtain shall be used.

These precautions are necessary in order to obtain a high early strength concrete and they are especially important in freezing weather.

(3) *Placing*—Concrete shall be placed before it has set enough to lose its plasticity, and it shall be well tamped immediately after placing. For pole foundations, it is important that the tamping be sufficient to exclude enough air to obtain a densely packed mass. When earth is backfilled over fresh concrete care shall be taken not to disturb the surface of the concrete.

Sidewalk and pavement patches do not require a special finishing surface layer, but the top surfaces shall be sufficiently troweled after the concrete has set slightly. The appearance of the finished patch shall equal that of the adjacent concrete in pattern and color.

(4) *Curing*—In freezing weather fresh concrete in pole foundations near the ground line shall be covered with at least 1 ft. of manure or hay (not straw) for a period of one week, and in non-freezing weather earth coverings shall be used. Both these protective coverings and the earth backfill which protect sub-surface concrete shall be placed immediately after the concrete surfaces are hard enough to resist marring. The purpose of the protective covering is to prevent freezing and too rapid drying.



TO be profitable, rural electrification projects must take advantage of every possible economy in maintenance and service expense. AmCreCo poles have proved their ability to offer an unusual economy in minimum annual upkeep costs. That is why they are such an important factor in lines which must pay dividends year after year.

AMERICAN CREOSOTING COMPANY
INCORPORATED

COLONIAL CREOSOTING COMPANY INCORPORATED

AMCRECO LOWRY PROCESS CREOSOTED WOOD

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ADDRESS INQUIRIES TO CHICAGO, ILL., OR LOUISVILLE, KY.

Industrial ELECTRIFICATION

New ideas and practices in industrial electrification as presented by industrial, consulting and power sales engineers

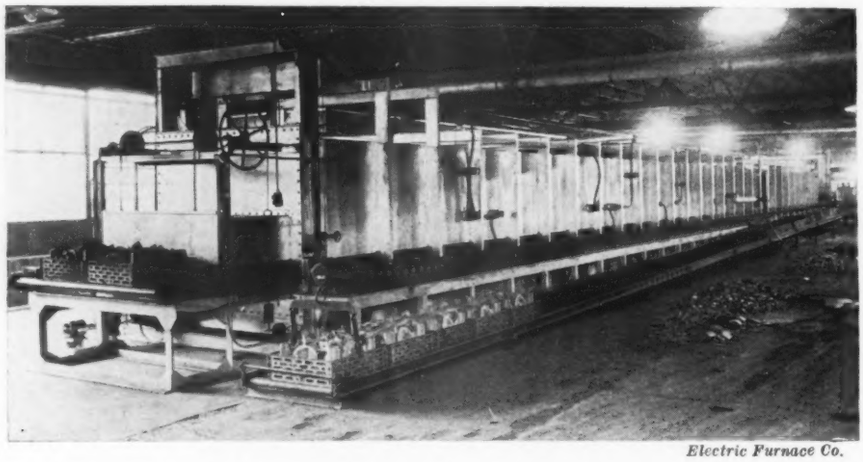
Anneal 35 Tons Daily in Automatic Furnace

Thirty-five tons of short-cycle malleable castings are clean annealed daily at a prominent malleable iron foundry in a modern, continuous, special-atmosphere electric furnace rated at 860 kw., a furnace which is of the continuous roller hearth type and operates on a cycle requiring approximately thirteen hours.

Heating elements are heavy, cast, nickel-chromium alloy grids located in both the roof and bottom of the heating and soaking chambers, above and below the material being heated. These elements are divided into seven separately and automatically controlled zones.

Castings to be annealed consist of miscellaneous shapes, both large and small, and are loaded onto alloy trays or baskets which travel through the furnace in two parallel rows directly on the rollers that serve as the furnace hearth. Trays are loaded on an extension at the charging end. At suitable intervals the door to the charging vestibule opens, an auxiliary, high-speed drive charges the trays into the vestibule, the outer door closes and as the door of the heating chamber opens automatically the material is conveyed inside. Trays after passing slowly through the heating and cooling chambers actuate a limit switch on reaching the discharge position. This automatically opens the discharge door and delivers the material to a gas lock chamber. With the door closed behind it, the trays are moved onto a transfer car and dumping equipment. A gravity conveyor returns the empty trays to the charging end, completing the cycle of operation.

Special non-oxidizing atmosphere is used throughout the heating and cooling chambers. The special atmosphere is produced in an Elfurno gas generator that is located alongside the furnace.



Electric Furnace Co.

Charging end of 120-ft. special atmosphere electric furnace for the scale-free annealing of short-cycle malleable castings

Note the absence of packing material around the castings and the 500-lb electric crane for handling full trays.

Shipbuilders Favor Electric Welding

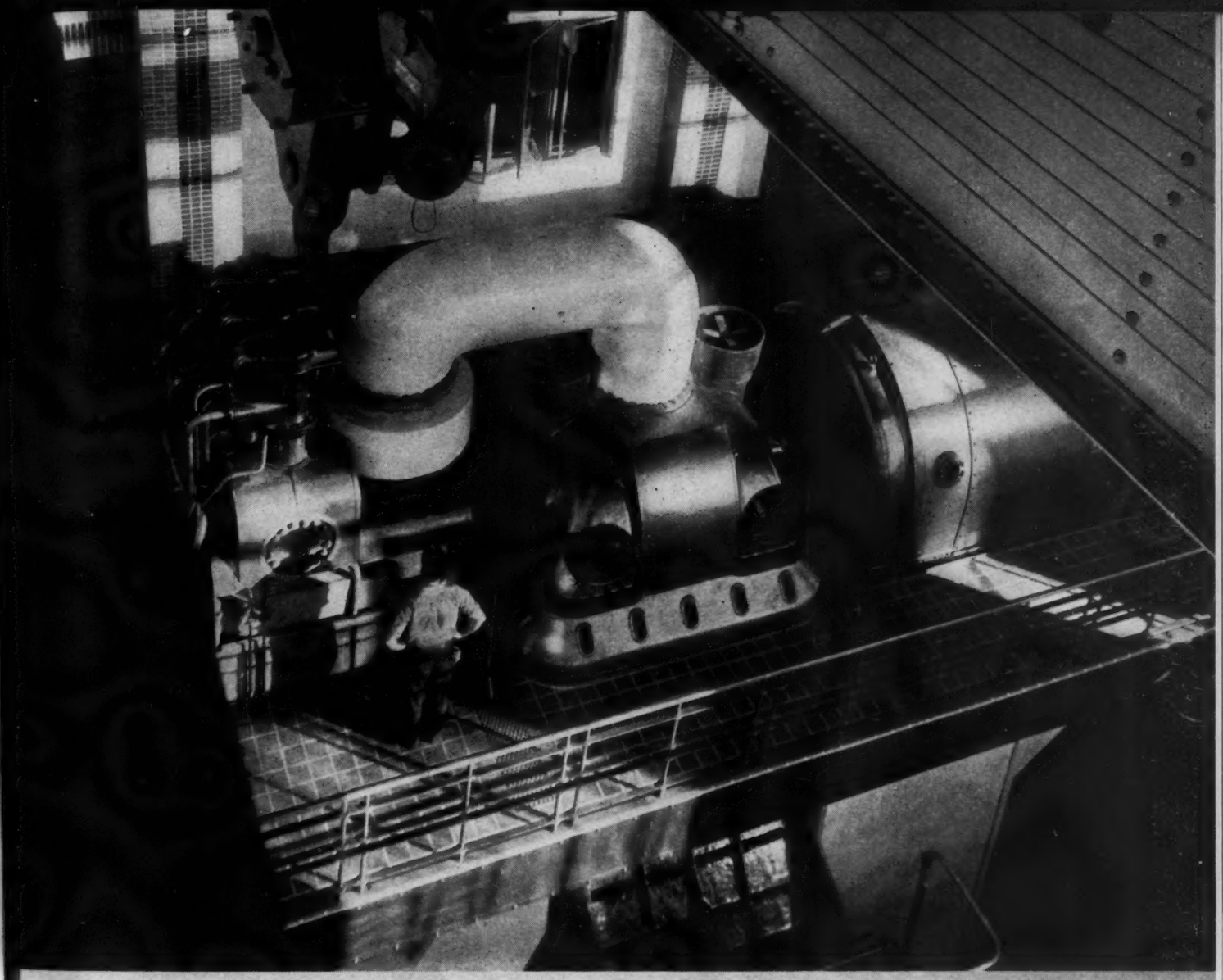
The shipbuilding industry put its stamp of approval on the use of electric arc welding in ship construction at a recent meeting of the Society of Naval Architects and Marine Engineers held at Chester, Pa. Three large tankers now under construction by the Sun Ship Building & Dry Dock Company are more than 18,000 tons dead weight and the entire tank space extending from the engine room bulkhead to the forward end of the tank space for a length of 353 ft. is of completely welded construction.

The half-day discussion which followed inspection of the work at Chester revealed an almost unanimous opinion that the ships of the future will be welded. Transportation is important in the petroleum industry and tankers are the least expensive method of transport when they can be used. The next method of oil transportation from the cost standpoint is the overland pipe line, and surveys indicate that arc-welded construction of pipe lines has become almost universal.

•

Spot-Welding Data for Non-Ferrous Metals

That the spot welding of non-ferrous group metals in similar and dissimilar combinations is not impossible of practical solution is shown by data obtained from a 100-kva., press-type welder controlled by an ignitron spot-welding timer on which successful welds of this type were made. Metal combinations shown in the accompanying tables were successfully spot welded using "Cupa-



POWER NEEDS PROTECTION

GENERATORS, great sources of electrical energy, would work in vain without adequate insulation. *Synthane* plays its part. *Synthane* protects—protects the flow of energy from generator to bus bar to substation to point of use. . . . *Synthane* has many other applications. . . . *Synthane* Bakelite-laminated is a uniformly dense, solid material possessing a combination of useful physical, chemical, mechanical and electrical characteristics. It is tough, strong and light in weight; one of the most effective dielectric materials; chemically inert and corrosion resistant. It is easy to machine. The uses for *Synthane* are countless. . . . *Synthane* is a type of material indispensable in insulating electrical products. It may similarly be of material assistance in the manufacture of your product. Write for "*Synthane* for Mechanical Applications". (Please indicate your requirements in your request.)... *Synthane* gives you *Material Satisfaction.*

SYNTHANE CORPORATION, OAKS, PENNSYLVANIA

SHEETS • RODS • TUBES • FABRICATED PARTS • SILENT STABILIZED GEAR MATERIAL

SYNTHANE

Bakelite— laminated

Metals Welded to the Same Material and Thickness

Metal	No. of Cycles Applied	Percentage of Machine Capacity Used	Tip Pressure in Pounds
0.025 Aluminum	1	63	400
0.0625 Aluminum	3	75	400
0.125 Aluminum	5	88	400
0.020 Sheet lead	1	7	125
0.0625 Sheet lead	1	18	200
0.125 Sheet zinc	5	80	300
0.050 Sheet brass	4	57	500
0.0625 Sheet brass	4	80	500
0.032 Nickel silver	2	18	400
0.032 18-8 Stainless	1	7	650
0.093 Tinned "Everdur"	5	57	500
No. 26 Gauge galv. iron	2	57	450
No. 20 Gauge galv. iron	2	62	500
0.010 Tinned sheet iron	2	70	470
0.010 Tinned sheet iron (three pieces, center one corrugated)	2	88	470
0.040 Sheet steel	3	7	470
0.050 Sheet steel	3	7	470
0.0625 Sheet steel	3	13	470

Metals Spot Welded to Other Metals and Thicknesses

Metal	No. of Cycles Applied	Percentage of Machine Capacity Used	Tip Pressure in Pounds
0.050 Brass to 0.050 Olympic bronze	7	57	450
0.062 Brass to 0.062 Olympic bronze	4	63	500
0.050 Brass to 0.0325 nickel silver	3	57	450
0.050 Olympic bronze to 0.032 stainless steel (18-8)	2	18	550
0.050 Olympic bronze to No. 20 gauge galv. iron	4	67	500
0.050 Olympic bronze to 0.050 sheet steel	2	32	470
0.032 Nickel silver to 0.032 stainless steel (18-8)	2	7	450
No. 26 Gauge galv. iron to 0.010 tinned sheet steel	2	57	400
No. 20 Gauge galv. iron to 0.040 sheet steel	3	13	400
No. 26 Gauge galv. iron to 0.032 stainless steel (18-8)	2	31	550
0.040 Sheet steel to 0.032 stainless steel (18-8)	2	13	550
No. 20 Gauge galv. iron to 0.032 cadmin-plated sheet steel	2	31	450

loy," a copper-chromium alloy, as welding point material. Point diameter was held to $\frac{1}{4}$ in. A 440-volt, 60-cycle primary current was used.

Each sample was tested as made and no weld was considered as accomplished until the spot produced had first-class appearance, was free from burrs, feathers, serious discoloration or indentation and on a test to destruction pulled a hole in the parent stock 3/16 in. in diameter.

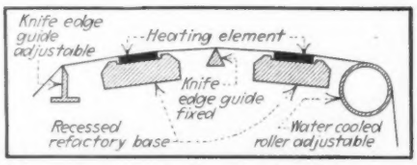
It was found, however, to be impractical to get a spot in the $\frac{1}{8}$-in. thick zinc which would tear the hole, due, no doubt, to the fact that the thickness was such as to make the circumferential cross-section around the spot greater than the area of the weld; the same was true of "Everdur." Zinc was the only one in which the indentation was at all serious. In zinc the indentation ran about 30 per cent of the thickness. In no other case did this amount to more than 10 per cent, according to H. Thomasson, welding engineer Canadian Westinghouse Company, Ltd.

•

Electric Heaters Singe Cotton Cloth

By WILLIAM H. PUTNAM
Consumers Engineer
Shanghai Power Company, Shanghai, China

Cotton fabric when it leaves the weaving loom has a definite "furry" or hairy surface, removal of which, by singeing, is one of the first stages in the preparation of the cloth for dyeing. Realizing the potential load which would accrue should a successful electrically heated singeing machine be devised, the Shanghai (China) Power Company's engineers recently carried out experiments to this end. It was learned, however, that a Japanese company, Fuji Shokai, Kyobashi Minamizume, Wakayama City, Japan, had perfected a successful electric singeing unit. Three local dyeing mills were induced to order and install units. From the interest shown by other mills, after operation for a year's period it is anticipated that further installations are imminent.

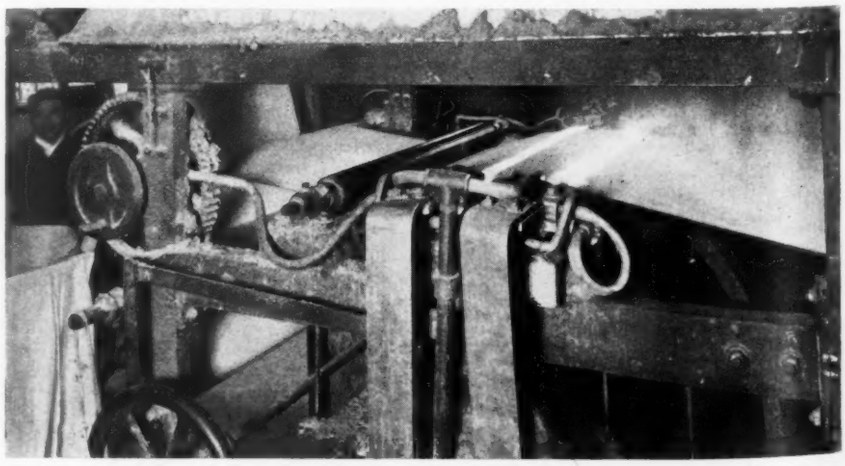


Arrangement of electric heating units for single side singeing

The actual heating unit consists of two bars of nickel-chromium iron alloy 1½ in. wide, ¼ in. thick and about 50 in. long, which lie horizontally about 3 in. apart on a recessed refractory base. Energy is supplied to each of the two bars through a separate 25-kva. step-down transformer having primary taps to provide secondary voltages of 8, 9, 10 and 11 volts. Both bars can of course be supplied through one 50-kva. transformer, but this creates an undesirable unbalanced load on a three-phase supply. Tap changing can be conveniently and quickly carried out on the control panel to give a range of operating temperatures approximating 1,000 deg. C. on the bars, depending on the weight of the cloth to be singed and the degree of singeing required.

It is reported that a speed of 200 yards per minute can be attained using this type of singeing, but it has been found that best results are obtained on speeds of from 120 yards to 150 yards per minute. An actual test on a machine over a prolonged period showed that 0.222 kw-hr. was consumed per 40-yard piece. Life of the resistor bar is guaranteed at a minimum of 1,500 hours continuous operation. At the slower speed of 120 yards per minute this represents a minimum output of 10,800,000 yards of material. Replacement cost of each bar is approximately $25.

A safety device, consisting of a quarter cylinder of sheet steel, fitted to the frame of the machine in such a manner that should a stoppage of the cloth occur it immediately rotates over the heated bars, simultaneously raises the cloth therefrom. This attachment is also used when starting, since it is necessary to keep the cloth from contact with the bar until the desired temperature is reached and the cloth can be put into motion. The section of the bar which is not in direct contact with the cloth is naturally excessively hot. To prevent the edges of the fabric from scorching, the exposed surface of the bar is cooled by a jet of air supplied by a small air pump.

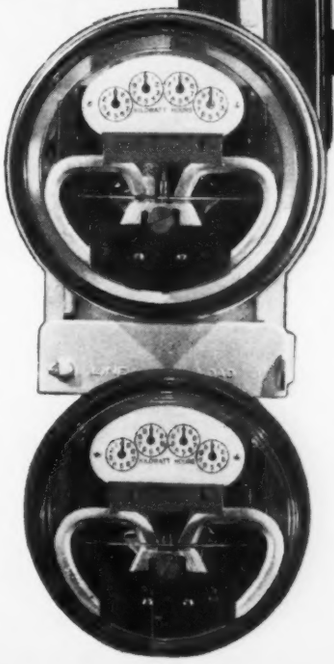


Electric heating units replace coal-heated copper plates for singeing cotton cloth
Units are rated at 50 kw. and are used for singeing one side at a time

ACCURATELY METERED— AUTOMATICALLY CONTROLLED

The Watthour Meter Manufacturers anticipated that commercial air conditioning loads would require special meters. They responded with new designs. Sangamo's contribution to this development is the line of single disk, two-element Type L-2 Meters.

Now, with the advent of "portable unit" air conditioning, Sangamo Time-Switches, too, serve this field. Through the time-switch, operation of the office cooler is discontinued after working hours, to be resumed at the proper time. Thus, by assuring completely automatic operation with a considerable saving in costs, the time-switch adds to the saleability of the cooler.



ABOVE: Form K Time-Switch controls nightly off-periods of office coolers. Other Sangamo Time-Switches operate any required air conditioning schedule.

LEFT: Type L-2 Meters, in modern "A" and "S" mountings, comprise two complete electro-magnetic elements driving a single disk.

SANGAMO ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS

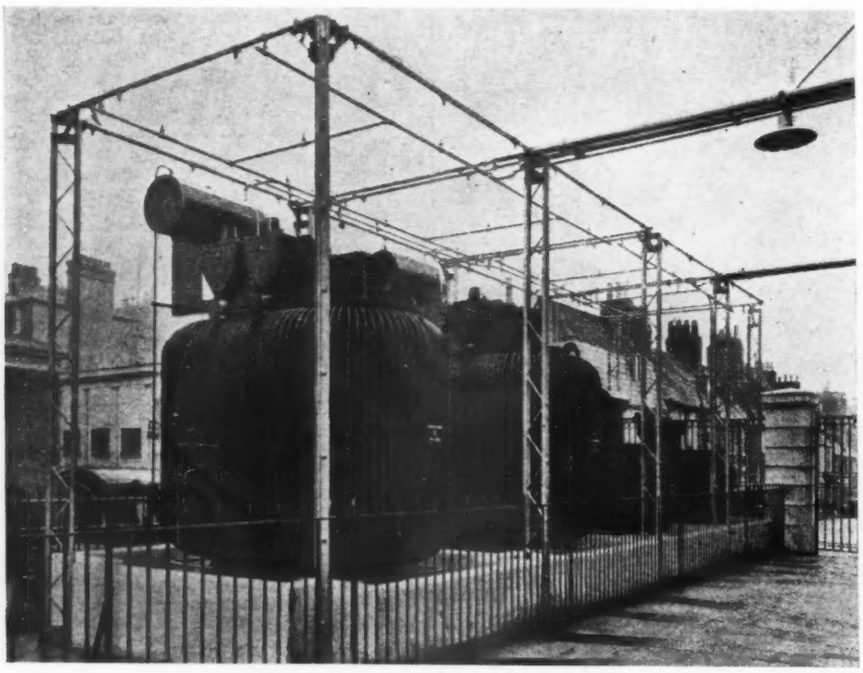
New ENGINEERING IDEAS

Discoveries, proposals and developments by electrical engineers and scientists in the field, the factory and the laboratory

Grid Transformers Guarded Against Fire

At a substation of the British grid in close proximity to dwelling houses, a Mather & Platt "Mulsifyre" fire extinguishing equipment has been provided. It depends for its action on the fact that if the surface of oil is emulsified it cannot burn, and the emulsification is produced by discharging water through projectors, which cause a spray to impinge with considerable force onto the oil surface. Only a thin film at the surface is emulsified and the fire is extinguished within a few seconds. The projectors pointing downward and another system of smaller piping with pilot sprinkler fitting pointing upward are to be seen in the illustration reproduced from the *Engineer*.

The system is filled with air under pressure and is connected to automatic hydraulic valves. Immediately a pilot sprinkler operates on the occurrence of a fire, the hydraulic pressure in the pipe falls as the result of a quartz bulb bursting, the hydraulic valve operates and the water is automatically turned onto the projector system. A water pressure of about 40 lb. per square inch is needed at the projector, and as this requirement is not met by the town's supply in this particular case a tank and pump have been installed. Air lines containing the fire detectors are pumped up separately to about 20 lb. per sq.in.



Water spray emulsifies surface oil

Besides the fire extinguishing system mounted above the transformers, there is a ring main round each tank with the projectors pointing upward.

•

Balance Scheme Improves Regulation

By HORACE G. WIEST, JR.
General Electric Company, Lynn, Mass.

Characteristics of the filaments used in series street lamps are such that a 1 per cent change in current produces a change in life of about 24 per cent and in light output of about 7 per cent. The best obtainable regulation of series-lighting transformers is therefore desirable. Recent improvements in constant-current street light transformers bring practical realization of the so-called "flat regulation" that has been the goal of recent experiments.

Regulation in movable-coil constant-current transformers has in the past depended largely on the accuracy with which the moment caused by the weight of the movable coil was balanced against the sum of the moments arising from electromagnetic repulsion and the action of a balancing counterweight. It was inherently impossible to get better than 1 per cent regulation due to the mechanical nature of the balancing scheme (Fig. 1). Since the movable coil is hinged at *S*, the moment arm of both the counterweight force (vertically applied) and the force of gravity (vertically applied) varied with load and by the same percentage. The action of the electromagnetic repulsion, however, is constant and lies always along the center of the core linking the two coils. Its value and mo-

It's a KEARNEY PRODUCT

Selecting An Expansion Anchor

If you'll consider all these factors before specifying expansion anchors, you'll be sure to make the proper selection: (1) the portion of the total area that contacts undisturbed earth (2) maximum anchor expansion (3) anchor's total surface area (4) material.

These are the fundamental factors that determine holding power—they are factors which Kearney Designing Engineers have taken into consideration in planning and designing Kearney Hi-Tension Expansion Anchors.

As a result, you may, in some instances, get the same holding power with a smaller Kearney anchor than you would out of a larger anchor of some other make. As you realize, if that be the case you might make a worthwhile saving. Ask a Kearney representative to explain this possibility, or,

Write for Further Details.

JAMES R. KEARNEY CORPORATION

4236 CLAYTON AVENUE

ST. LOUIS, MO.

FACTORIES: ST. LOUIS, MO.—TORONTO, CANADA

YOUR QUESTIONS OUR ANSWERS

Q. Is it a fact that all Kearney Anchors, the 2, 3 and 4-way Expansion Anchors and the Pipe Rod, Steel Rod and No-Rench Screw Anchors are all made of Certified Specification Malleable Iron?

A. Yes, Certified Specification Malleable is used because it affords (1) high tensile limits and yield points, (2) ductility to withstand breakage and abuse, (3) corrosive resistant qualities, (4) light weight thin cross-sections for easy installation, (5) uniformity of product.

Q. How does the 2-way Expansion Anchor here shown develop its tremendous holding power?

A. By having specially curved blades that exert upward as well as outward force against earth and so designed that they expand 2½ times their rated size to put 63% of their area in firm, undisturbed earth.

Q. What is the object of the nut retainer on Kearney Expansion Anchors?

A. The recessed socket provided in the disc permits the rod to be salvaged easily. Further, it prevents the rod from slipping through the disc and allows the anchor to be placed at the bottom of the hole with ease and convenience.

Q. Once expanded, are these Anchors positively secure?

A. Yes, a special off-set in the heavy rib under each blade locks them in the expanded position.

Solderless Con-Nec-Tites; T-Con-Nec-Tites; Lap-Tite Connectors; Trip Out Fuse Switches; Trip-O-Link Fuse Switches; Trip-Saver Fuse Switches; One and Two Insulator Fuse and Disconnect Switches; Porcelain Housed Tripomatic Fuse Cutouts; Double Duty Fuse Cutouts; Pole Top Gang Operated Switches; Porcelain Housed Disconnect Switches; N.E.M.A. Hook Operated Disconnect Switches; Fuse Links; Fuse Link Boxes; Fuse Pullers; Secondary Fuses; Screw Anchors; Expansion Anchors; Full-Vu Guy Guards; Guy Wire Clips and Strand Bands; Economy Cable Clamps; Dead-End Service Clamps; V-Groove Service Clamps; Hitemeters; "J" Hooks; Conduit Straps; ABC Sleeves and Machines; Cable Ring Saddles; Fit-Rite Wire Holders; Sleeve Twisters; Ground Wire Clips; Ground Clamp-Tites; Grounding Cable; Hi-Line Tools Accessories; Con-Nec-Tap Clamps; Grounding Sets; Masterenches.

JAMES R KEARNEY CORPORATION ST. LOUIS MO

The Mark of Quality Products

FUSES OF FAME

On guard—ready to save motor burnouts and damage to electrical equipment—Jefferson-Union Fuses by the millions have served the electrical industry since its earliest days.

Precision craftsmanship, advanced engineering, in-built accuracy,—combined with simplicity and ruggedness have made Jefferson-Unions the first choice of experienced electrical men .... Write for Fuse Data Bulletin and handy chart for determining proper fuse sizes.... JEFFERSON ELECTRIC COMPANY, Bellwood (Suburb of Chicago), Illinois. Canadian Factory: 535 College St., Toronto, Ont.

JEFFERSON UNION RENEWABLE FUSES

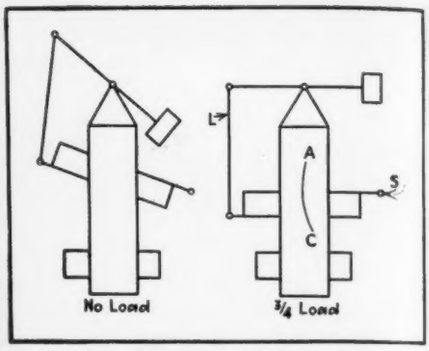


Fig. 1 — Old balancing system for constant-current transformer

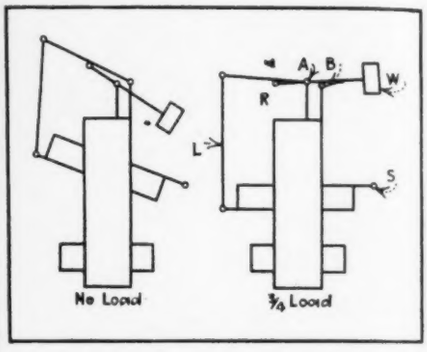


Fig. 2—New balancing system

ment arm does not change in the same proportion as the two others of the system of three moments. Thus the resultant of the three basic moments varies slightly with load.

In the improved design (Fig. 2) two levers are used, one attached to the link L and pivoted at B and one attached to the counterweight W and pivoted at A. The lever attached to L is supported by a roller R on the weight lever. This causes the force of the counterweight W on the link L to vary with load, so that the percentage variation in the moment of the counterweight about S is greater than the percentage variation in the moment of the weight of the coil. By suitably proportioning the levers the sum of the moments of counterweight and electromagnetic repulsion exactly equal the moment of the weight of the coil, so that the resultant is zero throughout the range of the load and optimum current regulation is obtained.

•

Foreign Phone Cable Uses Steel Sheath

Use of acid-proof welded steel instead of the ordinary lead sheath on a new telephone cable developed in Norway by Mr. Wassel of Drammen is of interest because of its possible

In the Bonneville Power House...

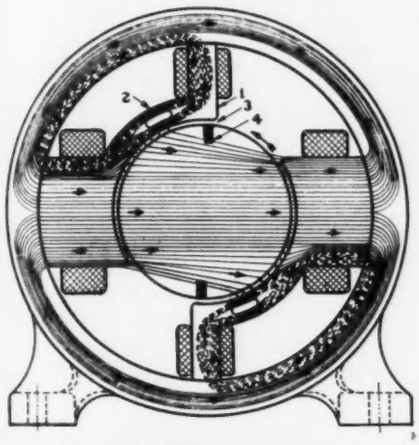
it's **ELECTRIC PRODUCTS**

DIVERTER POLE GENERATORS

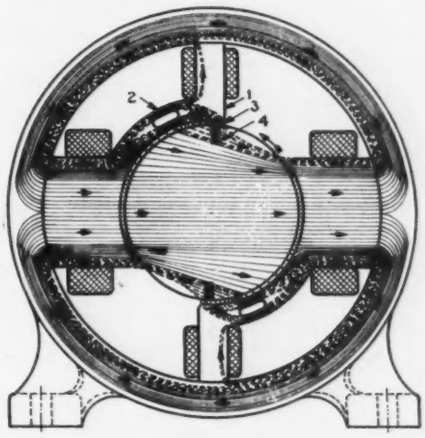
...Because They Fulfill the Highest Requirements for Battery Charging

● A Diverter Pole Generator might be described as a constant voltage generator whose polarity is non-reversible in charging storage batteries and which possesses inherent protection against overload.

At no load, a part of the magnetic flux resulting from the shunt coil on the main pole piece is diverted and does not pass through the armature. As the load increases, the series winding on the Diverter Pole rediverts this flux to the armature and provides a commutating field.

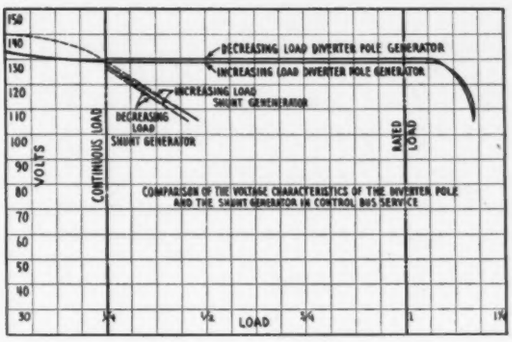


Magnetic flux distribution at NO LOAD, Mainflux — full lines; leakage flux — dashed lines.



Magnetic flux distribution at FULL LOAD. Mainflux — full lines; leakage flux — dashed lines.

INHERENT VOLTAGE STABILITY



The voltage curve above pictures graphically how a Diverter Pole Generator functions. There is a slight drop in voltage from no load to approximately full load. Momentary recovery to a slightly higher voltage, after switch operation, insures the generator voltage coming back to its original setting, and corrects any tendency of the voltage to vary. This is one of the reasons for the inherent stability of the generator.

The sharp drop of the voltage curve above full load protects generator and driving motor against overloads. As the generator carries the load up to its capacity the voltage during switch operation is maintained at a higher value.

INHERENT OVERLOAD PROTECTION

The Diverter Pole Generator has a fairly high degree of saturation in its magnetic circuit when operating at 130 volts (for 60 cells), yet is capable of operating at higher voltage for overcharging or equalizing, a feature much appreciated by those who feel that occasionally a voltage greater than 2.15 volts per cell is an advantage. Danger of overcharging is eliminated by Diverter Pole Generator inherent voltage regulation . . . and voltage remains constant month after month in automatic sub-stations without field rheostat adjustment.

Under no circumstances will the generator polarity be reversed when operating with a storage battery.

Write today for further information on why Diverter Pole Generators are better for floating with control batteries . . . and how they will help you!

The Electric Products Co.

CLEVELAND, OHIO

bearing on power cable manufacture abroad. This steel sheath serves the double purpose of protecting the interior wires and carrying the whole weight of the cable lengths between poles, to which it is fixed direct.

The cable developed weighs about 810 lb. per mile, has a breaking strength of about 4,000 lb. and the outside diameter of a ten-pair cable is approximately 9 millimeters, according to reports.

•

Electric Scoreboard Accurate as Watch

A new principle for driving the hands of scoreboard clocks makes them so accurate that they can be used for official timing of any game. The first installation, pioneered at Washington State College, consisted of a 9-ft. clock in the basketball gymnasium and a 17-ft. clock on the football field. These two clocks utilize a new principle whereby the power to operate the works is applied at the outer end of the second hand instead of at the central axis of dial.

Motive power is furnished by a 110-volt, 60-cycle synchronous motor geared to a connecting shaft installed under the large (second) hand. At the outer end of the shaft the motive torque for the hand is applied through a pinion running on a circular rack. The horsepower of the motor varies as to the size of the clock, a 16-ft. clock requiring 1/20 hp.

The hands are counterbalanced and pulled around the periphery of the dial, making the accuracy very great and not affected by wind no matter how large the hand.

The football timer at Washington State, the largest on the Pacific Coast, has a second hand 8½ ft. long. It operates on a fifteen-minute period, the regular football quarter. Time can be checked to 1/25 second. The basketball timer is similar, but on a smaller scale. It operates on a twenty-minute period, the regular basketball half. This clock can be checked to 1/64 second.

The patented principle of this clock permits the construction of clocks of large size that will operate accurately. Regular time indicators can be constructed as large as 150 ft. across the face, which is three times the size of any clock now operating in the world, making them adaptable to unusual and spectacular layouts in connection with electric display signs where extraordinary reader interest is desired.

New driving mechanism makes outdoor clock as accurate as the finest stopwatch

Propulsive power is applied at outer end of the large (second) hand, which makes one revolution per minute. The official timer of the game stops and starts the clock with a hand switch that can be carried around the field if desired. The second markers on the dial are 12 in. apart.

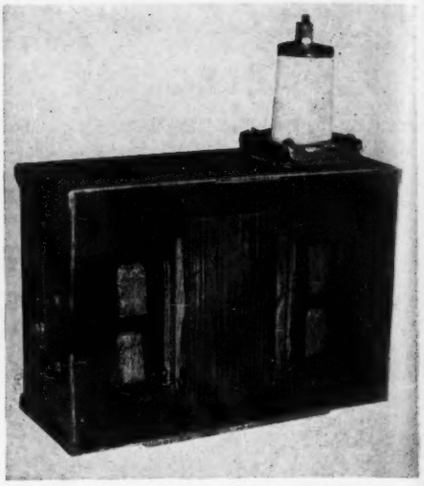
•

New Compound Fine for Small Transformer

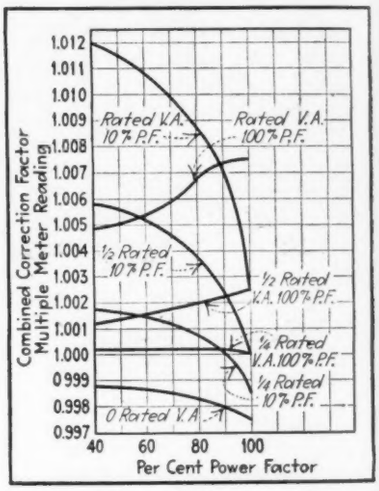
By E. C. WENTZ
Transformer Engineer Westinghouse Electric & Manufacturing Company, Sharon, Pa.

A new type of fluid insulation, which has none of the limitations of oil for insulating transformer windings has been developed and a process for introducing it into transformer cases had been perfected. The new compound is a very viscous material of high dielectric strength; as used in its first application in a new line of voltage transformers (Westinghouse, type "PT"), its strength is at least double that of oil. It is introduced under vacuum at high temperature and completely impregnates the windings and fills the case as well. After it has cooled it is stiff, flows only very slowly and is practically fireproof.

Its use is limited to small transformers and voltage transformers because of its poor heat conductivity. However, most small transformers, particularly those for high primary voltage, can be made much smaller if the designer takes proper advantage of the superior qualities of the compound.



Half of a type "PT" voltage transformer, obtained by sawing it longitudinally



Compound-insulated transformer has accuracy as voltage transformer

Obviously, voltage transformers are a class in which best results can be expected.

To make the best use of the compound to reduce the transformer size, it should cover the inner ends of the primary bushings, as this will reduce the required creepage distance over the inner ends of the bushings. If the transformer case is solidly filled this result will be accomplished, and, in addition, the transformer may then be mounted any side up. A case with a flexible wall will take care of expansion at ordinary temperature and loading.

These possibilities have all been incorporated into the new designs of Westinghouse types "PT" and "PTO" voltage transformers, with the result that they are in general smaller, yet more accurate, and have much higher impulse voltage strength than previous designs, either dry type or oil insulated. The case is hermetically sealed, precluding deterioration of the insulation.

"... the mounting load curve is forcing new projects into the engineering departments of hundreds of power companies—thus affecting all lines of electrical manufacturing."

Yes, sir,
Electrical Buying
for 1938
Has Already Started!

... But what make of equipment will be specified? Whose equipment will be bought? You already know the answer. Orders have a better chance of going to those alert manufacturers who advertise their products in the publication which has the confidence of the buyers.

If you want to sell the electrical industry (light and power companies, electrical manufacturers, industrial electrical engineers), then concentrate in the industry's FIRST paper, Electrical World.*

In short, follow the lead of the pace-setters who are placing their advertising in the business-stimulating pages of Electrical World.

* Electrical World shows up First consistently, year after year, as the preferred publication among readers. They ought to know!
— it has the greatest A.B.C. paid circulation . . . 15,626 net paid, June, 1937.
— it carries three times the advertising of the nearest comparable publication.

ELECTRICAL WORLD

A McGraw-Hill Publication • 330 W. 42nd St., New York, N.Y.

Building Up THE LOAD

New ideas and practices in selling electrical equipment and service to commercial and domestic customers

Harvard Print Shop Modernizes Lighting

Twenty-eight units, each consisting of a 30-in., 275-watt, low-pressure mercury-vapor tube with auxiliary equipment and four 150-watt tungsten bulbs, deliver 40 ft.-candles on the imposing stones and type racks of the Harvard University printing plant in Cambridge, Mass. Alzak aluminum reflectors with suitable shields and diffusing glass to eliminate glare and loss of light are included in each unit. This modernization, under the supervision of R. B. Johnson, head of the maintenance division, replaced an archaic lighting installation embodying small units inadequately distributed for the work required under modern conditions.

The composing room, formerly a college dining hall, is 67 ft. long by 65 ft. wide by 40 ft. high. Where they serve the inclined benches, the units are suspended directly over the aisles; they are placed directly above the imposing stones, where these are to be illuminated. In general, the rays from the units strike the type at right angles to the plane of letter surfaces. Since each unit has 576 sq.in. of diffusing glass area, the flux distribution is unusually even.

The units are suspended 8 to 9 ft. above the floor on messenger cables, there being four units per cable. A turnbuckle is provided on each cable for convenient adjustment; for each span a central wire is run to the ceiling to cut down sag. Each lighting unit is served independently by a three-wire cable which is carried along the messenger, one of the wires being grounded.

From the standpoints of intensity, quality and simulation of daylight the results have been excellent. The same type of fixture has been employed over the desks of the foreman and proofreaders and the absence of shadows throughout the entire plant is notable. Equipment was furnished by the General Electric Vapor Lamp Company. Willard Thompson, Boston, was consultant on the project.

Print shop, former dining hall, receives 40 ft.-candles from combination mercury-vapor and incandescent units

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Air Conditioning in Thin Territory

By J. W. ANKENMANN
Sales Engineer
Northwestern Public Service Company,
Huron, S. D.

At first we thought we would only assist the dealers in obtaining air-conditioning business. That is, furnish them with prospects and then wash our hands of the deal. Such a policy did not work. Our property extends over the better part of three states and is 900 miles from one end to the other. The various dealers could not afford to cover such an expanse profitably. In other words, one week we would have a 3-hp. prospect at one end of the property and the next week a 5-hp. prospect at the other end.

To remedy this we decided to furnish to our employees an air-conditioning manual written in very elementary language. The purpose of the manual was to acquaint our employees with air-conditioning fundamentals, enabling them to see its possibilities and equipping them to furnish necessary pertinent data for an engineering estimate. This manual was furnished primarily to give our employees a background of information to help them make out a data

"It's Good!"

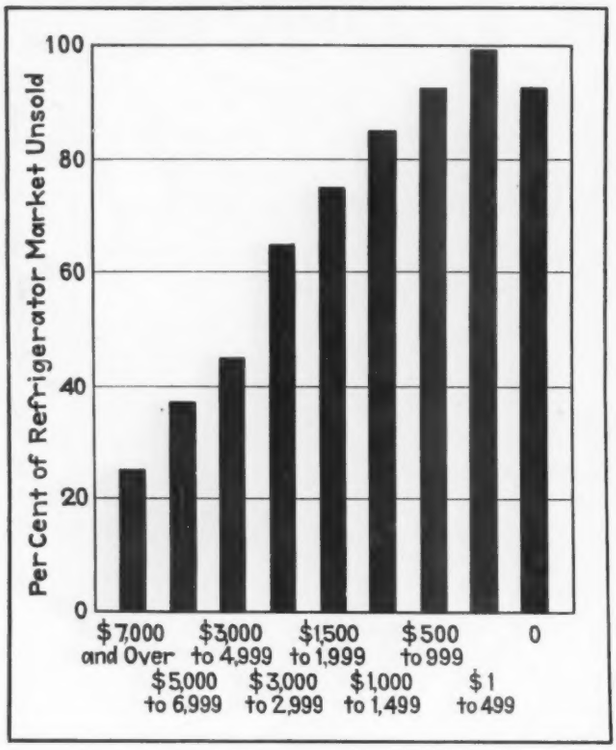
● Thud!—An instant of pop-eyed suspense and the roar from the stands means "It's Good"—because the foot of the kicker met the ball at the vital spot and angle. . . . Also, every electric heating device has its vital spot, a part from which radiates the heat that is as clean as sunshine. Known as the Heating Element, it also is in fact the vital element . . . vital to the performance of the equipment, whether it is a lovely little device for the table or a strong, rugged furnace for industry. So, we are in a vital business—as the producers of Chromel—the heating element alloy around which annually thousands of table appliances, ranges and industrial furnaces are built; equipment of which the maker is proud and with which the customer is pleased—because of Chromel it may truly be said, "It's Good". For technical data, ask for Catalog-L which contains usable and useful information. Hoskins Manufacturing Company, Detroit, Mich.

H O S K I N S

CHROMEL

THE WIRE THAT MADE Chromel ELECTRIC HEAT POSSIBLE

WHAT IS THE DOMESTIC ELECTRIC REFRIGERATION MARKET IN 1937?



Here is one picture of the unsold market for domestic electric refrigerators this year. Nash Kelvinator adds this prediction: 5 per cent of refrigerator buyers will have incomes over $5,000, 10 per cent will have incomes from $2,500 to $5,000, 15 per cent will have incomes from $1,800 to $2,500 and 70 per cent will have incomes below $1,800! Hence, they say, the big market is in the lower income groups, to whom the selling program should be directed.

Nash-Kelvinator Corporation

sheet; we did not propose to make them air conditioning engineers. With the manual we supplied a number of data sheets, upon which could be noted such data as would be needed to lay out any given space for air conditioning.

The success of the data sheet has been evidenced in several quotations wherein, without having seen the space to be cooled, we have been in line on our quotation. One particular quotation comes to mind wherein we were within $16 on an installation amounting to $3,000.

The success of an engineering estimate depends upon the completeness of the data sheet. If all data are supplied, and supplied correctly, we can be within reason. Naturally it is better to see the place to be cooled, or heated, before a final layout is given.

Until the public becomes educated to the buying of proper air conditioning we will have undersized jobs. To educate the public will take time. We are helping our customers by a very definite direct mail scheme. We obtain the mailing pieces from air conditioning manufacturers and have also issued some of our own. Two of our own are "What Do You Want in Air Conditioning?" and "A Guide to the Buying of Air Conditioning." We are educating our architects, by contracts and general data, assisting them in layouts and specifications. In other words, we are assisting our customers in obtaining good sound installations whenever possible.

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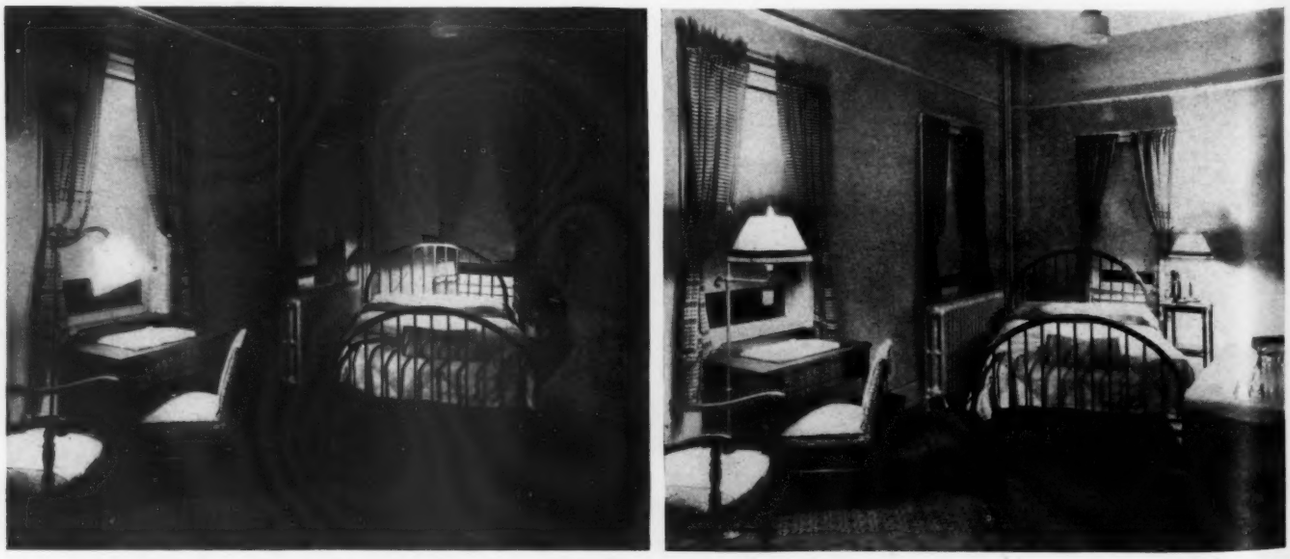
I.E.S. Lamps in Hotel Appeal to Salesmen

Credit for an installation of 42 I.E.S. lamps in the Cadillac Hotel, Rochester, N. Y., is given an alert company employee by the Rochester Gas & Electric *News*. Noticing the dim light on the hotel manager's desk, this employee brought an I.E.S. lamp to the hotel and suggested that the manager try it out on his desk. Trial "sold" the manager.

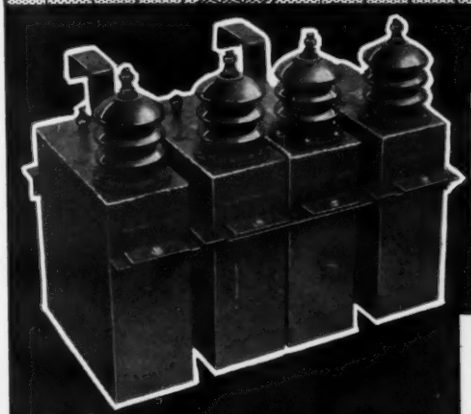
Repeated requests from traveling salesmen for better light to make easier their task of making out lengthy sales reports made a change in the hotel's lighting system necessary. A transient who made his first stop in the hotel the afternoon the lamps went in said: "The I.E.S. lamps made me feel very much at home. Making out my reports became a much easier task and, take it from me, whenever I am in Rochester the Cadillac is going to be my home."



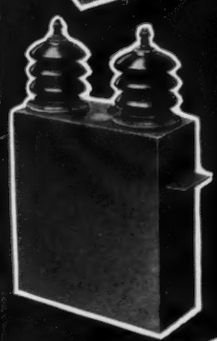
More light on sales reports—A typical single room in the Hotel Cadillac illustrates the difference between old lighting (left) and better light produced by new lamps (right)

Rigging Feeders for more KW Hours

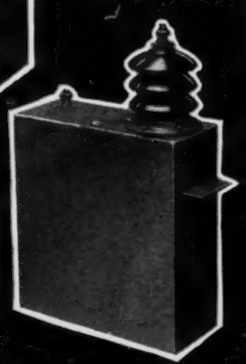
with CORNELL - DUBILIER POLE-TYPE CAPACITORS for POWER-FACTOR CORRECTION on distributing systems.



Four 15 kva units mounted on multiple cross-arm mounting bracket.



2300, 4000 and 4600 volt, two-bushing, 15 kva pole mounting unit. May be mounted singly or in groups with pole-mounting brackets.



2300, 4000 and 4600 volt, single bushing, 15 kva pole mounting unit. One terminal grounded to case.

Cornell-Dubilier pole-type capacitors have proven most effective and economical for power-factor correction and voltage regulation on distributing systems.

Typical example of tremendous savings effected by power-factor correction toward voltage regulation:

A large public utility recently found it necessary to boost system capacity; cost of added generating and sub-station equipment would have been $40,000.00
Investigation proved that similar results could be obtained by a capacitor installation costing only $7,000. Net savings. . . .$33,000.00

Investigate this low cost method of adding KW capacity to your system. C-D engineering field offices throughout the United States will gladly cooperate with you in planning your requirements. Full technical data supplied on request.

A few of the outstanding features that make these efficient, easily mounted, flexible capacitors ideal units to use on power lines are:

- Impregnated and filled with non-inflammable and non-explosive DYKANOL.
- Sturdy and superior construction, based on more than twenty-seven years of experience in the exclusive manufacture of capacitors.
- Rugged, extra large, glazed porcelain insulators, with three petticoats, assure protection against flash-over dangers and damage due to handling in the field.
- Extra strong welded steel case, protected by two coats of weather-proof paint.
- Special design allowing for air cushioning of expansion and contraction.
- Standard Mounting dimensions.

NEW CATALOG

WORLD'S LARGEST AND OLDEST MANUFACTURER OF CAPACITORS

CORNELL-DUBILIER Electric CORPORATION
South Plainfield, N. J.

CORNELL-DUBILIER ELECTRIC CORPORATION EW 9-11
SOUTH PLAINFIELD, N. J.

Please have your representative call ☐ send catalog ☐

Name.....

Address.....

City.....*State*.....

News ABOUT PEOPLE

W. E. Mange Assigned Duties With Staten Island Edison

Winthrop E. Mange, formerly general manager of the New Bedford Gas & Edison Light Company, has been elected vice-president and general manager of the Staten Island Edison

Corporation to take over the work of F. D. Campbell, who has assumed new duties in New York.

Mr. Mange had been with the Associated System since he joined the New York State Electric & Gas Corporation as distribution engineer in 1922. Later he was general manager of Paul Smiths Electric Light & Power Company, Paul Smiths, N. Y., and subsequently was connected with the Management Corporation in New York and with the Pennsylvania Electric Company. During 1926 and 1927 he was assistant general manager of Staten Island Edison Corporation. In 1928 he went to Hyannis, Mass., as general manager of the Cape and Vineyard Electric Company.

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► E. B. MORRISON of Portland, Ore., was elected president of the Northwest section of the International Association of Electrical Inspectors at the recent convention in Salt Lake City. E. M. McLaughlin of Richmond, Calif., was elected president of the Southwest section.

► J. W. DEVEREAUX, Public Utility Engineering & Service Corporation, has been elected chairman of the Chicago section of the Illuminating Engineering Society.

► W. M. SHOBER, formerly a distribution engineer, Department of Water, Light and Power, city of Springfield, Ill., is now an electrical installation engineer for the Aluminum Company of America, Alcoa, Tenn.

► JOSEPH B. MONTGOMERY, JR., who became associated with the Empire Sheet & Tin Plate Company August 1, assuming charge of sales, has been elected vice-president in charge of sales. Mr. Montgomery was previously connected with the sales organization of the Bethlehem Steel Corporation.

► ROSS M. WHITE has resigned as general construction superintendent of the Tennessee Valley Authority, to become general manager of Brown & Root, Inc., and McKenzie Construction Company, contractors for the Marshall Ford Dam on the Colorado River near Austin, Tex. Mr. White will remain with TVA as a consultant on construction problems. He will leave the Authority on October 15.

► CARL E. PETERS has been appointed secretary of the B-L Electric Manufacturing Company, St. Louis, Mo. Mr. Peters has been connected with the B-L company and its affiliate, the Benwood-Linze Company, since 1921. IRVIN W. VEIGEL, who has been associated with the company since 1931, has been appointed treasurer. Mr. Veigel is also comptroller.

Utility Management Names Campbell Vice-President

Floyd D. Campbell, president of the Staten Island Edison Corporation, Staten Island, N. Y., has been elected vice-president of the Utility Management Corporation. Mr. Campbell will continue as president of the Staten Island utility, but he will have his office with the Management Corporation in New York City. He will become the contact supervisor of properties of New England Gas & Electric Association.

Mr. Campbell has been with the Associated System since he joined the staff of W. S. Barstow & Company, now E. M. Gilbert Engineering Corporation, in 1919. He was later with General Gas & Electric Corporation, was at one time general superintendent

of Pennsylvania Edison Company and assistant general manager of New Jersey Power & Light Company. Before going to Staten Island he was general manager of what is now the South Carolina Electric & Gas Company, Columbia, S. C.

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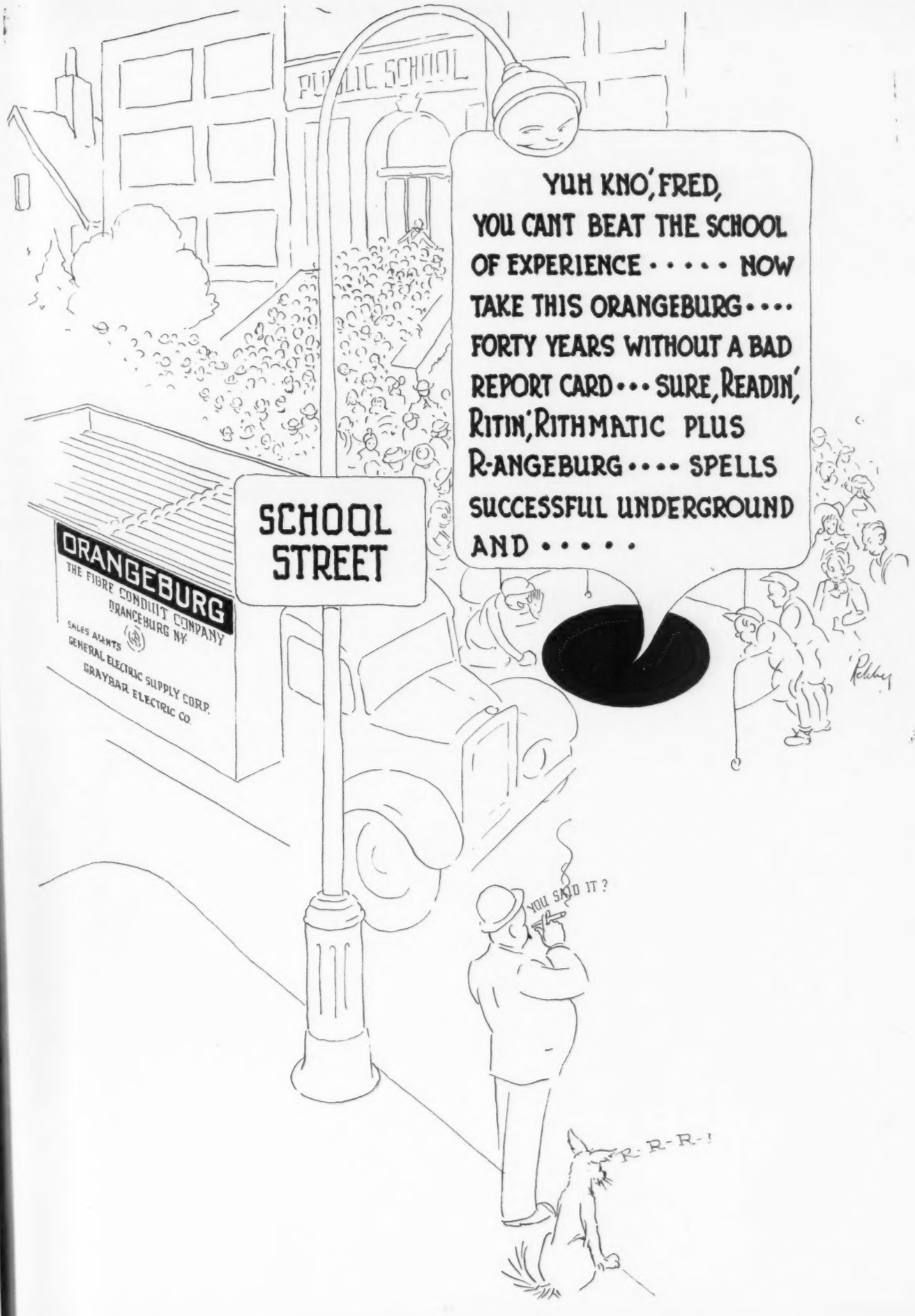
► J. SHELLY RAGLAND, formerly illuminating engineer at Richmond for the Virginia Electric & Power Com-


PUBLIC SCHOOL
YUH KNO', FRED, YOU CANT BEAT THE SCHOOL OF EXPERIENCE ····· NOW TAKE THIS ORANGEBURG···· FORTY YEARS WITHOUT A BAD REPORT CARD··· SURE, READIN', RITIN', RITHMATIC PLUS R-ANGEBURG···· SPELLS SUCCESSFUL UNDERGROUND AND ·····
SCHOOL STREET
ORANGEBURG
THE FIBRE CONDUIT COMPANY
ORANGEBURG N.Y.
SALES AGENTS
GENERAL ELECTRIC SUPPLY CORP.
GRAYBAR ELECTRIC CO.
YOU SAID IT!
R-R-R-!

pany, is now sales manager at Fredericksburg. Mr. Ragland is a graduate of the University of Virginia.

▶ JOHN J. DUGGAN has been appointed president of the Chapman Valve Manufacturing Company, Indian Orchard, Mass., and FREDERIC C. LOW has been named treasurer. Both of these men have been with the organization for more than 30 years. For the past twenty years Mr. Duggan has been treasurer.

▶ HAROLD J. MERILEES, for the past six years on the publicity staff of the British Columbia Electric Railway Company at Vancouver, B. C., has been appointed to take over the organization and administration of the sales promotion work of the company under W. C. Mainwaring, general sales manager. A native of Vancouver, Mr. Merilees spent six years with the advertising and merchandising departments of David Spencer, Ltd., at Vancouver before joining the staff of B. C. Electric in 1931. Since that time he has handled merchandising advertising under the direction of James Lightbody, publicity manager.

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Allen B. Dumont Photograph

The photograph which accompanied the article on Wilbur B. Driver in ELECTRICAL WORLD, August 28, page 80, was of Allen B. Dumont, president of Allen B. Dumont Laboratories.

R. J. Cordiner Made Manager of G. E. Appliance Sales

Ralph J. Cordiner, assistant manager of the appliance and merchandise department of General Electric Company, has assumed the additional duties of general manager of appliance

sales to succeed P. B. Zimmerman, who resigned to accept an executive position with the Norge division of the Borg-Warner Company in Detroit.

Mr. Cordiner is one of the youngest men in the electrical industry holding so important a position, but his experience has been exceptionally broad. After ten years with the Edison General Electric Appliance Company on the Pacific Coast, he went to Bridgeport in 1932 as manager of the heating device section. Two years later, when the radio division was formed, he was placed in charge, and in 1937 he was named assistant manager of the appliance and merchandise department.

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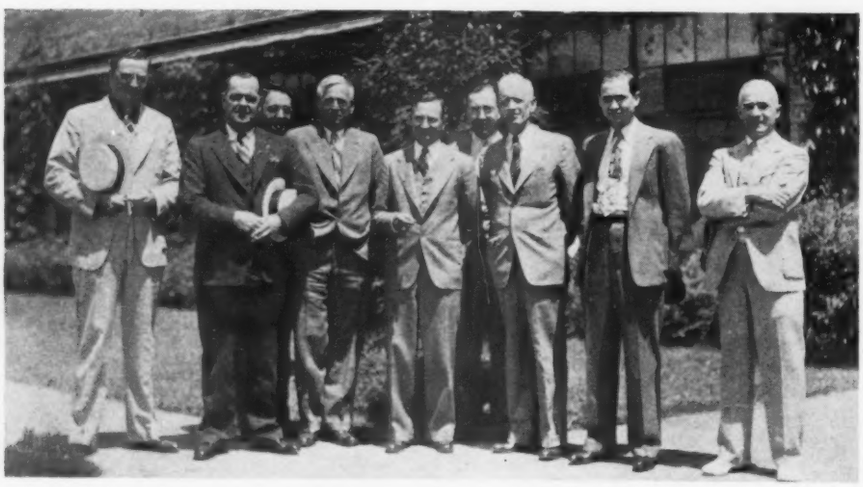
OBITUARY

▶ EDGAR D. EDMONSTON, for many years general superintendent of electric operations of the Consolidated Gas, Electric Light & Power Company of Baltimore, died August 29 at Blue Hill, Maine, following an operation. He was 60 years old. A native of Washington, D. C., and a graduate of Lehigh University, class of 1898, Mr. Edmonston immediately entered the electrical engineering field. He joined the Baltimore utility in 1908 as superintendent of construction. Three years later he was appointed general superintendent of electric operations, the position he occupied at the time of his death. Mr. Edmonston was a member of the American Institute of Electrical Engineers.

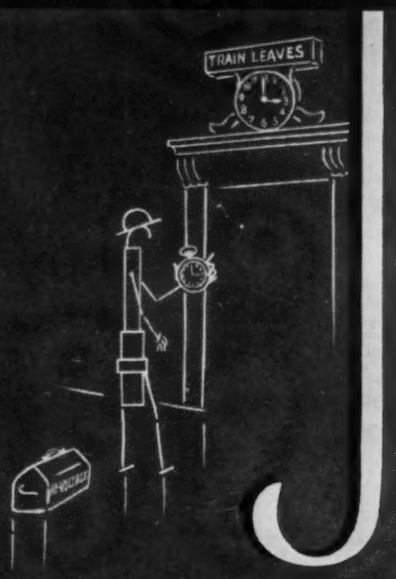
▶ HERMAN DIEDERICHS, dean of the College of Engineering at Cornell University for the past year, died August 31, in his sixty-fourth year. Before he was chosen dean of the college of engineering he had been head of the Sibley School of Mechanical Engineering at Cornell since 1921. Professor Diederichs began his university career at Cornell almost forty years ago. He was regarded as an authority in experimental engineering and had written extensively on engineering subjects. He was a member of the American Society of Mechanical Engineers, the Society of Automotive Engineers and the Society for the Promotion of Engineering Education.

▶ MAURICE COSTER, who served as vice-president of the Westinghouse Electric International Company from its formation in 1919 until his retirement in 1930, died in Magog, Quebec, Canada, at the age of 82. Mr. Coster had been associated with the Westinghouse organization since 1888. He was a fellow of the American Institute of Electrical Engineers and one of the founders of the American Manufacturers Export Association. Mr. Coster was also one of the first fifty members of the National Foreign Trade Council.



LIGHT PLANT MANUFACTURERS MEET—Problems of mutual interest in the manufacture of engine-driven lighting plant equipment recently brought together officials of leading companies for a meeting at Oshkosh, Wis. The manufacturers were guests of the Universal Motor Company

(Left to right) R. G. Klieforth, Universal Motor; D. W. Onan, D. W. Onan & Sons; A. F. Sheller, Le Roi Company; R. K. Schriber, United States Motors Corporation; M. W. Flader, Kohler Company; M. H. Rutishauser, Harnischfeger Corporation; P. A. Tanner, Johnson Motors; D. E. Bright, Pioneer Gen-E-Motor Corporation; H. A. Mitchell, Continental Motors.



JUST RIGHT!

NOT TOO FAST

To permit the breaker on the secondary to function.

NOT TOO SLOW

To prevent line outage due to primary fault. Clears 20,000 ampere short in ½ cycle.

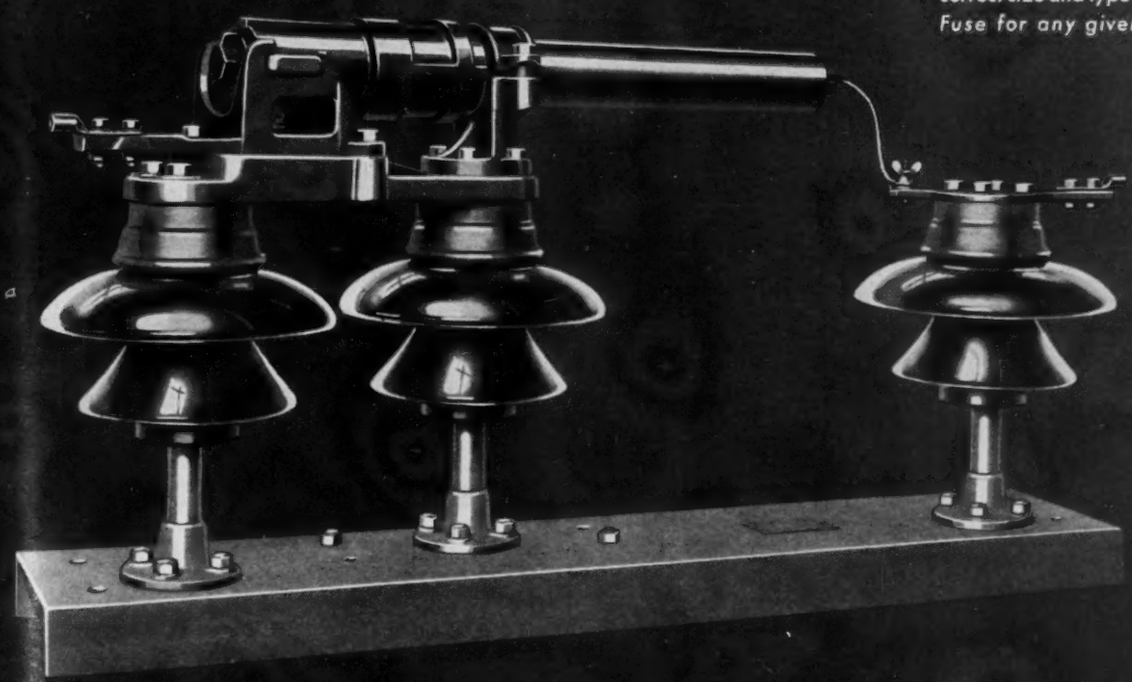
ABSOLUTELY RELIABLE

HI-VOLTAGE Fuses have proved their reliability in both extensive tests and wide service. The burning of the fuse link creates a high pressure within the tube, thereby expelling the gases and any unconsumed portion of the link, at a high velocity. *The arc is cleared within the fuse tube;* the air gap serving chiefly to prevent any leakage of current through or over the fuse tube after the fuse has blown. The tubes are so proportioned that high pressure and velocity are developed on light loads, thereby *clearing any load that will melt the fuse wire.*

HI-VOLTAGE FUSES

Establish an air gap in the line simultaneous with the blowing of the link.

BULLETIN NO. 24 gives all of the information required to select the correct size and type of HI-VOLTAGE Fuse for any given requirement.



HI-VOLTAGE EQUIPMENT CO.

2891 EAST 79TH ST., CLEVELAND, OHIO

Manufacturing AND MARKETS

Plans Completed for League Meeting

Plans for the second annual conference of the International Association of Electrical Leagues, to be held in the auditorium of the Electrical and Gas Association of New York on October 6 and 7, are practically completed. Nationally known speakers will address the conference on all phases of electrical business development operations.

The first day and the morning of the second day will be open sessions to which all branches of the electrical industry are invited. The regular monthly luncheon meeting of the New York Association has been scheduled for October 6 at the Astor Hotel, a special feature of the Conference activities. The speaker of the day will be Floyd L. Carlisle, who will take for his subject "The Interdependence of the Various Branches of the Electrical Industry and the Necessity for Full Co-operation Among Them."

Speakers who will discuss business development activities at the various sessions include:

National Kitchen Modernizing Activity, G. E. Whitwell; Electrical Housewares Program, C. E. Swartzbaugh; Adequate Wiring, M. E. Skinner; Cooperative Dealer Merchandising in the Metropolitan New York Area, E. F. Jeffe; Street & Highway Safety Through Lighting, L. A. S. Wood; Institutional Safety, M. Porosky; Air Conditioning Promotion, E. J. Heggarty; Range Promotion, G. J. Reichert; Radio Promotion, Harry B. Brown; Laundry Equipment Promotion, J. M. Michael; Sales Financing Plans, Roger Steffan.

•

Air Conditioning Exports Advance Sharply in 1937

Rapid expansion of foreign sales of air conditioning equipment was indicated by figures issued by the machinery division of the Department of Commerce, which showed such export sales for the first six months of this year valued at $704,756, compared with $863,482 for all of 1936.

In 1935, which was the first year in which export figures for air conditioning equipment were segregated, the exports totaled $320,558. The value of the exports for the first half of this year were 89 per cent ahead of the value for the first half of 1936. The Union of South Africa and Argentina were the best foreign customers.

•

Manufacturers Make Sales Appointments

Electrical manufacturing companies have recently made the following appointments to their sales staffs:

Foster Wheeler Corporation has appointed John H. Lenaerts special representative in the general sales department with headquarters at 165 Broadway, New York.

Harnischfeger Corporation of Milwaukee has appointed C. H. Boenig of Youngstown, N. Y., as P & H sales engineer, to handle the entire line of Harnischfeger products in the western section of New York, including Buffalo with Rochester as the eastern boundary line.

Allen-Bradley Company, Milwaukee, announces the appointment of the Wilson Electrical Equipment Company, Houston, Tex., as its new representative in the southern territory. The recently organized Delavan Engineering Company, Des Moines, Iowa, has been appointed representative in the Iowa territory.

Terry Steam Turbine Company has appointed Walter Cooke district representative in New Orleans, Cowles & Company in Dallas, Tex.: M. N. Dannenbaum Company in Houston, Tex., and W. V. C. Jackson in Tulsa, Okla.

Lincoln Electric Company announced the opening of a new sales engineering office in Bluefield, W. Va. The new office will be in charge of William H. Schuster. Walter D. Wood, Jr., has been appointed to the sales staff of the Philadelphia office.

Allis-Chalmers Manufacturing Company has transferred to Seattle Stephen C. Bacon from the home office at Milwaukee. Mr. Bacon will be sales representative in the Northwest.

Graybar Electric Company has appointed J. E. Murray manager of the Graybar House at Wichita. Mr. Murray was formerly outside construction manager at Kansas City.

G. E. Heating Course for Power Salesmen

More than 100 power salesmen from leading electric-service companies in various parts of the country will gather in Schenectady, N. Y., September 20 for a five-day course, sponsored by General Electric Company, in industrial heating practices and applications. During the sessions, attention will be focused not only on new types of equipment available and new developments in the art, but on potential markets for industrial heating as well. Factory trips, for the purpose of demonstrating modern heat-treating equipment at work, are planned for General Electric's Schenectady and Pittsfield plants.

Engineers of electric-service companies, and industrial companies interested in heat-treating, will join with G-E specialists in presenting papers.

Principal speakers at a dinner meeting on Wednesday, September 22, will be E. O. Shreve, General Electric vice-president in charge of sales, and W. H. Sammis, Commonwealth & Southern Corporation.

•

Turbo-Generator Bids Asked

State Electricity Commission, Melbourne, Victoria, Australia, will receive bids until October 12 for a 30,000-kw. steam turbo-generator, with condenser and complete accessory equipment, for installation in Newport "B" power station.

•

First Issue of "Hot Water"

The water heater division of the Edison General Electric Company, of Chicago, has published the first issue of a news-pictorial in rotogravure to promote the Hotpoint electric water heater. The publication is entitled

THERE'S no "kid glove" handling required with this conduit. It's Bermico Dura-Cell, the only conduit made tougher and more durable by the use of virgin wood fibre.

Fibre, processed directly from wood, remains tough and springy. And this unweakened fibre builds into Bermico Dura-Cell the sturdier, more resilient "backbone" that stands up under abuse and the blows and impacts imposed during conduit installation. This extra strength means added years of trouble-free cable protection.

Bermico Dura-Cell offers other savings, too. A non-split coupling ends the expense and loss of time involved in replacing broken couplings. Lighter weight reduces trucking and handling costs.

In choosing conduit, remember:

Bermico Dura-Cell's added toughness means added protection for your cables and added savings for your company.

WHY THIS NEW COUPLING CAN'T SPLIT

Driving forces tapered conduit ends solidly against fillet in center of coupling. Pressure is held on direct line through fillet. Ends cannot wedge and press outward to split the coupling.

BERMICO
DURA-CELL CONDUIT

A PRODUCT OF BROWN COMPANY, PORTLAND, MAINE

EXCLUSIVE DISTRIBUTORS

WESTINGHOUSE ELECTRIC SUPPLY COMPANY

BRANCHES IN EVERY LARGE CITY

"Hot Water" and will be issued quarterly throughout the year for mailing by Hotpoint's customers to electric water heating prospects.

General Electric Employees Have Long Service Records

More than 40 per cent of the employees of the General Electric Company have worked with the company for ten or more years, according to a recent survey. Those employed more than five years number 42,785, while those with ten or more years of service total 32,019. Fifty-three employees have been with the company 45 or more years; more than 200 for 40 years or more, more than 1,000 for 35 years or more. Those eligible for the Quarter Century Club number 6,383; 11,705 have worked twenty or more years and 19,773 have been employed fifteen or more years.

Charles J. Leephart of the general office, Schenectady, has 54 years of continuous service, and Roderick S. McNeil, appliance and merchandise department, Bridgeport, 50 years.

•

York Gets Queens Contract

Contract for the complete air conditioning of the Queens County Court House, Jamaica, Long Island, has been awarded to the York Ice Machinery Corporation. Contract provides for a 430-ton air-conditioning installation.

•

New $250,000 Plant Started

McGraw Electric Company has commenced construction of a new $250,000 plant at Elgin, Ill. The company expects to complete building operations about January 1, 1938. The factory building will have 100,000 sq.ft. of space on one floor and will be constructed entirely of daylight glass and steel. A two-story brick office building will house administrative quarters.

New York Metal Prices

	Sept. 1, 1937 Cents per Pound	Sept 7, 1937 Cents per Pound
Copper electrolytic	14.00*	14.00*
Lead Am. S. & R. price	6.50	6.50
Antimony	15.75	15.75
Nickel ingot	35.00	35.00
Zinc spot	7.60	7.60
Tin Straits	58.75	58.75
Aluminum, 99 per cent	20.00	20.00

* Delivered Connecticut Valley.

Field Reports on Business

Although an upturn in business is anticipated this fall, industrial leaders are carefully analyzing present trends as the basis for future commitments. The weakness in security prices since middle August has been discouraging and has accentuated the seasonal decline in business.

PACIFIC COAST

San Francisco building permits for August decreased about 20 per cent over August last year, though about equaling this July in all except public structures. The Bay region may become the long-predicted battleground between CIO and AFL groups, with San Francisco and Oakland parts tied up because of longshoremen and teamster strife.

Heavy stock buying during the spring price increase period and subsequent attempts to liquidate stocks unjustified by current demand is causing weakened markets in such staples as iron conduit, rubber-covered wire and flexible metallic conductors. Small appliances continue surprisingly active and manufacturers' representatives report a 50 per cent average increase over holiday orders placed last year. Major appliances seem unable to overtake 1936 figures.

A $40,000,000 fair for Seattle in 1942 is being discussed. Power machinery orders reflect the increasing industrial development, including a 625-450-hp. motor, value $13,000, for an oil company; switchgear equipment for a paper mill, value $7,500; a group of oil fuse cutouts, value $3,500; elevator controls, value $3,000, and regulators and switchgear, value $9,000, to serve a new industrial area. These orders indicate the present trend of such material which is for smaller and more diversified orders in contrast to the huge federal project awards of midyear. San Francisco is placing a $50,000,000 bond issue on the November ballot requiring a two-thirds vote in favor of a rapid transit subway system for five-year completion and the unification of existing publicly and privately owned lines. Other measures for inclusion on the same ballot will probably include a $3,220,000 courts building and $2,850,000 airport improvements.

CHICAGO

Not much change occurred in the business picture during the past week. Manufacturing and trade was dull, which is characteristic of the end of the summer season. That a large proportion of the people have money to spend, however, is evident from the unusually great amount of activity in travel and recreational pursuits.

Lighting equipment manufacturers are enjoying particularly good business. One order received last week amounted to $7,000 for store fixtures. Other recent orders include 40 large floodlights, 287 industrial units and 450 indirect office fixtures. Street lighting fixtures and traffic lights are moving at a good pace. Scattered orders for heavy industrial equipment are being placed. Utility purchases are steady.

Appliance sales are gratifying and air-conditioning installations are averaging 25 per cent above last year. Telephones in use are 54,000 greater than at this time a year ago. Electrical permits issued show a large volume of additional outlets being installed, as are neon window signs.

Employment in Chicago rose contra-seasonally 0.4 per cent last month while pay rolls declined 1 per cent. At the close of the month employment was 13.5 per cent ahead of a year ago and wages were 25 per cent higher. There was an exceptionally light volume of packing house commodities produced and building activity recorded further recessions.

NEW ENGLAND

Industrial electrical equipment sales are encouraging and are in good volume. Last week eleven automatic control switches were purchased from the Gamewell Company, Newton Lower Falls, Mass., at a cost of about $1,000. Special electrical equipment for use in connection with the new 5,200-ft. aerial tramway is included in a contract recently received by the American Steel & Wire Company at an estimated total cost of about $250,000.

Heavy electrical machinery is quiet. Negotiations are being carried on by engineers in this district for a substantial amount of fall business.

Merchandising is spotty but considerably ahead of last year in volume to date. In the Boston district sales for the first nine months of this year will be more than 25 per cent over last year, according to a well-known representative.

Assurances that two new destroyers will be built at the Charlestown navy yard point to further advances in buying electrical equipment in this district. The Westinghouse Electric & Manufacturing Company plans a $400,000 warehouse and service plant for South Boston to be built by Stone & Webster Corporation and completed by April 1938. New construction to date in this district is slightly ahead of last year.

NEW YORK

The extreme caution which has characterized business during the past several weeks has accentuated the seasonal decline in activity, in the opinion of some observers. The cooler weather which has replaced the recent hot wave is expected to spur trade in many lines. The decline in security prices has caused a great deal of uneasiness, for the stock market is still considered by many as a barometer of business.

Many industrial leaders believe that the trend of business during the next few weeks will indicate what the fall and winter hold. While the hope for a general upturn in the fall is general, business men are looking more at the cold facts and declare they will act accordingly. It is hoped also that the Administration will give business a chance to recover and give some encouragement.

The situation as it stands today leaves business at the crossroads seeking a direction to a more favorable outlook. Higher power production, increased appliance sales and the continued upturn in earnings have all tended to encourage the utilities. The pending utility cases and the pressing of the federal power program, with its subsidized competition, clouds the outlook.

Advertisement

COPPER ALLOY BULLETIN

Reporting News and Technical Developments of Copper and Copper-Base Alloys

SEPTEMBER — "Bridgeport" BRASS CO. — 1937

SOIL-CORROSION STUDIES OF METALLIC COATINGS

Supplementing an earlier report on Soil Corrosion Studies of Non-Ferrous Metals (See COPPER ALLOY BULLETIN, *June, 1937*), the National Bureau of Standards has issued another report (*Research Paper No. 982*), on field tests of non-bituminous coatings for underground use.

Observations cover a number of coatings on pipe specimens. Those calorized by the powder process showed higher rates of loss of weight and lower rates of maximum penetration than samples calorized by the dip process. Lead coatings were perforated in most soils, and corrosion followed.

Galvanized steel, over a 10-year period, lost weight at one-half to one-fifth the rates for bare steel. Poorly drained acid soils were severest on the galvanized pipe.

A 2.8 oz. coating of zinc per square foot of exposed surface prevented formation of measurable pits in most soils for a ten-year period without any appreciable influence of the type of ferrous material over which it was applied.

The former report indicated that copper and alloys high in copper corroded slowly in most soils. They should be used for permanence.

DOMESTIC COPPER OUTPUT UP 60%; IMPORTS DROP

Smelter production of primary copper from domestic sources in 1936 showed a 60% increase over the figures for 1935, according to an advance report issued by the Bureau of Mines. 1936 figures were 1,222,819,396 pounds, compared with 762,587,340 pounds in 1935.

Imports of copper into the United States dropped from 515,364,526 pounds to 380,677,700 pounds, indicating a sharp rise in the proportion of copper coming from domestic sources.

NEW WELDING SYMBOLS

New welding symbols, sufficiently comprehensive to carry exact information from the designer to the welder, have recently been adopted by the American Welding Society. Superseding symbols established in 1929 and revised in 1935, the new system is flexible enough to permit ready adaptation to the specific drafting-room requirements of individual companies, while still retaining the elements of the established standard.

Information on these new symbols can be obtained from the American Welding Society, 29 W. 39th St., New York City.

MUCH PROGRESS MADE IN DEVELOPMENT AND SELECTION OF ALLOYS FOR CONDENSER TUBING

Cooperative Investigation and Better Understanding of Problems Have Led to Development of More Efficient Materials

The past decade has seen much progress in the development and production of copper alloys for condenser and heat-exchanger equipment and there is considerable evidence that these alloys are now generally specified in fields where corrosion resistance is a factor in determining material selection. Likewise, investigation and accumulation of data and case histories have placed the analysis of problems involved in the selection of the most suitable alloy for any specific installation on a more scientific basis.

More Alloys Available

There are a number of alloys, all more or less commonly employed in condenser and heat-exchanger equipment and available to the engineer.

Admiralty	Red Brass
Cuzinal	Cupro Nickel 70-30
(Aluminum Brass)	Cupro Nickel 80-20
Duronze II*	Muntz Metal
Duronze IV*	Copper (arsenical)
(Aluminum Bronze)	Copper (deoxidized)
Tin Red Brass	Aluminum Brass

There are also a number of other special alloys that may be manufactured to individual specifications. All vary in cost and in degree of resistance to different types of corrosion which complicates the matter of most efficient and economical selection.

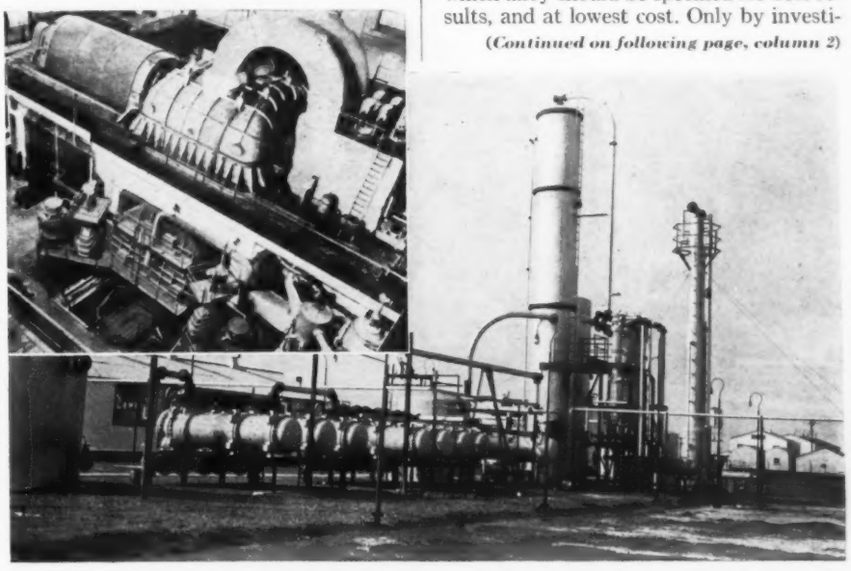
The problem is to determine in advance which alloy should be specified for best results, and at lowest cost. Only by investi-

(Continued on following page, column 2)

WORLD'S FAIR METAL EXHIBITS

Metals and metal products will be displayed at the New York World's Fair of 1939 with a prominence proportionate to the part which they play in today's civilization, it was recently announced by officials of the Fair.

Metals will be exhibited in the Hall of Production, which will occupy a position in the Fair grounds second only in importance to the Theme Center. The structure will provide 22,144 sq. ft. of exhibit space.



TOP: The largest single unit condenser ever built contains 17,700 Admiralty Tubes made by Bridgeport Brass Company. BELOW: A battery of heat-exchangers used in a recovery system in the petroleum refining industry. Equipment like this represents a tremendous capital investment and its continued operation at maximum efficiency has an important bearing on operating costs. That is why selection of the brass, bronze or copper alloy best engineered to meet specific conditions of an individual installation is vitally important.

PREPARED EACH MONTH BY THE BRIDGEPORT BRASS COMPANY

Headquarters for Brass, Bronze and Copper

COPPER ALLOY BULLETIN

NEW DEVELOPMENTS

All items in this column are from sources believed to be reliable. Further information on any of them may be obtained by writing the Bridgeport Brass Company.

A flexible shaft buffer is designed to handle short jobs and occasional work. Buffer can be supplied in floor, suspension, or bench type model, and is available in two sizes. The smaller size has a ¼-h.p. motor and a 4-foot shaft; the larger size has a 1/3-h.p. motor and a 5-foot shaft.

A rack of heavy construction is suitable for stacking pipes and bars. Rack consists of two upright assemblies connected by formed channel plates. Brackets for supporting pipes or bars are bolted to uprights. Each bracket has a clear depth of 12 inches and will support a load of 2,000 pounds.

A new insulating compound is reported to be highly resistant to moisture, acids, alkalies and oils. The compound can be made soft and flexible or as rigid as celluloid. It can be applied by much the same methods as rubber, but unlike rubber it will not support combustion. It is said to be suitable for power and control circuits up to 600 volts. It is available in a variety of colors for circuit tracing.

Pole top switches of heavy capacity are reported to stay in adjustment for long periods without attention. Blade operating mechanism can be securely locked in the proper adjustment. Operating pipes are furnished with drop-forged fittings. Piercing type set screws punch holes in the pipes after final adjustments are made. Switch is rated at 34,500 volts, 2,000 amperes.

Color effects on metal are reported to be obtained by an electrolytic process recently developed. The process is said to produce practically any color within the range of the spectrum over almost all base metals. The colors obtained are light-fast. By masking parts of the surface, two or more colors can be obtained on the same article.

Metal spray guns, generally associated with the finishing of manufactured products, are being used for the application of metal finishes to walls for interior decoration.

Cable terminators, manufactured in ratings from 7.5 to 30 kilovolt-amperes, are designed to insure vacuum tightness under severe conditions. Terminators use stud connectors made from hard drawn hexagon copper rod. Seating shoulders are built up of laminated spring bronze. When cap nut is tightened, laminations press on hood nut gasket, compensating for temperature changes and gasket aging.

Terminal blocks are available in 4, 6, 8, and 12-wire sizes. The block is constructed of molded bakelite. Connectors are inserted in the block after molding and grip the wire by a screw and spring clip.

CONDENSER TUBE ALLOYS

(Continued from preceding page, column 3)

gating conditions and weighing *all known factors affecting tube life in the actual job involved* can selection be accurately made.

The difficulty in choosing the best alloy is well illustrated in the case of one condenser where tubes installed in winter gave perfect satisfaction, yet tubes of the same alloy of identical manufacture installed in summer showed traces of pinhole attack within a very short period. A check revealed that the water conditions varied seasonally so that a permanent protective film was built up on the metal in winter, but no film was formed when the tubes were installed in summer.

Clearing House of Experience

Recognizing the value of actual service experience in determining and recommending alloys as best suited for any job, and also as a guide in developing and testing new alloys, the Bridgeport Brass Company has accumulated reports on a great many installations of all types. Assembled over a period of years, these reports cover the alloys used, the length of service life attained, the requirements, pressures, temperatures, water conditions, etc.

Thus, when an inquiry is received on a new or retubing job, an experienced Bridgeport condenser man is placed on the job to see that every influencing factor is checked before a recommendation is made. In this way, most satisfactory results can be obtained at the lowest practical cost. This is typical of Bridgeport service.

PLANS FOR METAL SHOW

Plans are well under way for the Annual Metal Show at Atlantic City, October 18 to 22. Exhibits at the show will feature non-ferrous metals, heat-treating and finishing methods, welding and cutting equipment, and various types of steel.

Cooperating with the A.S.M. in the preparations for the exhibit are the Iron and Steel and Institute of Metals divisions of the American Institute of Mining and Metallurgical Engineers, the American Welding Society, American Society of Mechanical Engineers, and the Wire Association.

Wire rope slings are particularly useful for handling rod and pipe in loads up to 7,000 pounds. Fitted with double hook assembly.

BRASS TERMINOLOGY

This is the fourth of a series on the nomenclature peculiar to the industry specializing in the making of brass, bronze and copper alloys. Another article will appear in next month's issue.

Previous articles in this series have discussed the more important forms of brass, bronze, and copper alloys. Copper itself is also manufactured and sold under a variety of designations. These designations refer sometimes to the method of production, and sometimes to the content of the copper; the designations are therefore not necessarily mutually exclusive.

Electrolytic Copper, as the name implies, is copper that has been refined by the electrolytic process. This method of refining produces a high degree of purity. Electrolytic Copper, which accounts for the bulk of the copper produced in this country, is supplied in the form of wire bars for rolling into rod and wire; cakes for rolling into sheet and strip; ingots for remelting into brass; and billets for piercing into tubes.

Tough Pitch Copper is produced by melting refined copper in a large furnace and blowing air through it to burn out some of the remaining impurities. The oxygen is then removed almost completely by putting large green wood poles into the furnace. The remaining oxygen (about 0.05%) produces casting qualities that result in smooth-surfaced bars, cakes, and ingots.

Deoxidized Copper is produced from Tough Pitch Copper by adding phosphorus, calcium boride, or calcium lithium to the molten metal. This process removes the small amount of oxygen which remains in the Tough Pitch stage. Deoxidized Copper is used chiefly in the form of billets for piercing into tubing; to a lesser extent in cakes for rolling into sheet. Deoxidized Copper will stand more severe cold working, bending, and flanging than will Tough Pitch Copper. It is somewhat more difficult to machine.

Phosphorized Copper is copper which has been deoxidized by phosphorus and in which a small residual amount of phosphorus remains. A small excess of phosphorus is usually employed in the deoxidizing process, and this excess remains in the product. Because phosphorus is the most commonly used deoxidizer, most Deoxidized Copper is also Phosphorized Copper.

PRODUCTS OF THE BRIDGEPORT BRASS COMPANY

Executive Offices: BRIDGEPORT, CONN.—Branch Offices and Warehouses in Principal Cities

SHEETS, ROLLS, STRIPS—*Brass, bronze, copper, Duronze,** for stamping, deep drawing, forming and spinning.

CONDENSER, HEAT EXCHANGER, SUGAR TUBES—For steam surface condensers, heat exchangers; oil refineries, and process industries.

PHONO-ELECTRIC* ALLOYS—High-strength bronze trolley, messenger wire and cable.

WELDING ROD—For repairing cast iron and steel, fabricating silicon bronze tanks.

LEDRITE* ROD—For making automatic screw machine products.

BRASS "Bridgeport" CO.

COPPER WATER TUBE AND FITTINGS—For plumbing, heating, underground piping.

DURONZE ALLOYS—High-strength silicon bronzes for corrosion-resistant connectors, marine hardware; *hot rolled sheets* for tanks, boilers, heaters, flues, ducts, flashings.

BRASS, BRONZE, DURONZE WIRE—For cap and machine screws, wood screws, rivets, bolts, nuts.

FABRICATING SERVICE DEPT.—Engineering staff, special equipment for making parts or complete items.

BRASS AND COPPER PIPE—"Plumrite"* for plumbing, underground and industrial services.

*Trade-name.

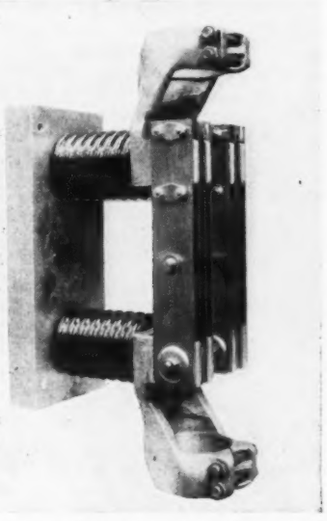
Established 1865

BRIDGEPORT BRASS

New EQUIPMENT AVAILABLE

Disconnect Switch

Improved high-ampere capacity disconnecting switches of the type illustrated feature tongue type silvered contacts engaged by double full floating blades. The terminals integral with the switch contacts



Group-operated disconnect; 4,000 amp., 23 kv. **Delta-Star Electric Company,** Chicago, Ill.

are of the clamp type for connecting 4-in. I.P.S. copper tubing. The wet process porcelain insulators have metal inserts to which the switch parts are bolted. All bolts, nuts and washers on the live parts are non-ferrous.

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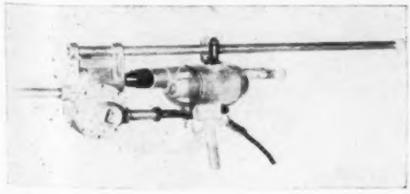
Power Wrench

Essentially a portable worm gear power drive operated by any standard make electric drill, this power wrench may be used



Bardwell portable power wrench; used with ½, ⅝ or ¾-in. electric drills; torque output 100 to 400 ft.-lb. depending on drill used; worm gear ratio 30:1. **W. C. Lipe,** Syracuse, N. Y.

on any heavy-duty job where rotating motion is required. The torque developed is said to be equal to the turning strength of three or four men. The steady pull and high starting torque of the wrench are said to make it ideal for driving winches, hoists, gates, valves and intermittently operated machinery. Power companies may find it useful as a drive for winches used in pulling cables or operating hydro plant head gates, it is said.

•

Cable Seals

"Sali" cable seals; for service up to 750 volts; (4) styles, for upright conduit, inverted or horizontal conduit, upright cable only, inverted or horizontal cable only. **Adalet Mfg. Co.,** Cleveland.

A new development in low-voltage cable seals, for sealing off the ends of lead cable to prevent moisture entering the cable at the termination of the lead sheath, is announced. Bodies and covers are of "sali," a special phenolic laminated material said to have high mechanical and dielectric strength. No metal parts project beyond the belled lead sheath which is clamped between the "sali" and an aluminum washer; these do not rotate when the body is screwed to the conduit or fitting coupling, this preventing the tearing of the lead sheath. Individual cable conductors are brought out for connection to equipment.

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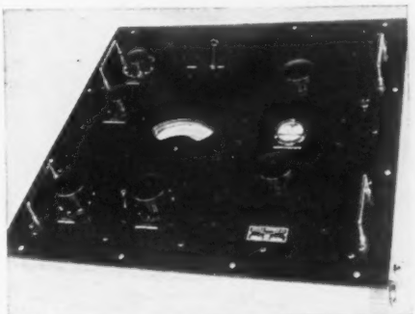
Cable Power-Factor Measuring Equipment

Equipment is newly available for making high-voltage production tests of power cable insulation by the power-factor method. This



Described in catalog E-54 (3). **Leeds & Northrup Company,** Philadelphia, Pa.

equipment, which uses the phase defect compensation method, is said to afford an accurate means for making tests since it does not depend on the deflection of the wattmeter used. Inductance is introduced in the potential circuit of a sensitive dynamometer so as to reduce its deflection to zero and avoid the necessity of calibrating the instrument. An initial adjustment of the zero of the power factor scale is made by applying suitable compensation when using a high-voltage zero loss air capacitor in place of the cable. The inductor then reads directly in per cent power factor.

A.C. Arc Welder

Developed to meet the need for the low cost a.c. welder for use in maintenance and repair as well as in light construction work, this portable welder embodies a transformer and control particularly designed for a.c.

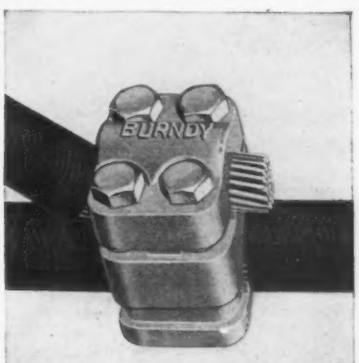
"Midget Marvel"; 50- and 60-cycle models: for use with coated electrodes from 1/16 to 5/32 in. **Westinghouse Electric & Mfg. Co.,** East Pittsburgh.

arc welding. Operating efficiency averaging 87 per cent at normal loads is claimed for the set. Twelve steps of current adjustment provide a range of from 30 to 140 amp. Secondary open voltage is 50 on low range and 55 on high. Primary input current for welding at 140 amp. is 70 amp. at 110 volts, 35 amp. at 220.

•

Gutter Tap

Constructed in three sections telescoped together and held in place by Everdur cap screws, this new gutter tap accommodates

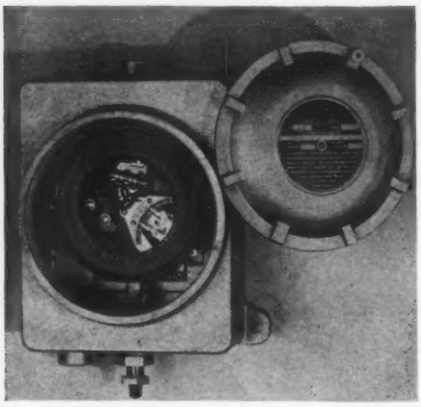


Type QPR; line covers range from No. 8 solid to 2,000 mcm. inclusive. **Burndy Engineering Co., Inc.,** New York.

a range of conductor sizes. It can be quickly installed with the use of a single wrench and may be easily taped. Use of carefully controlled alloys with a high content of copper is said to assure high conductivity and ruggedness.

Explosion-Proof Controls

Explosion-proof automatic controls are a recent announcement. Consisting of a glass tube containing sealed contacts of special material and a quantity of mercury to make or break the circuit when the tube is tilted,



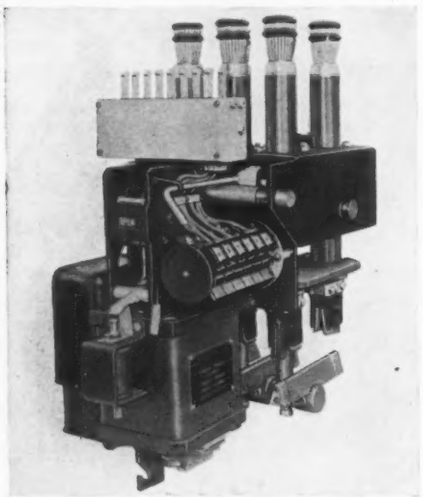
Type M-80 "Mercoid" automatic control in explosion-proof housing. **The Mercoid Corp.**, Chicago.

the switch used in these controls is built so there is no danger of arcing, oxidation or corrosion, it is claimed. For places so hazardous that double protection is wanted, the new explosion-proof cases are used. Several types, for a variety of applications, are available, including pressure controls ranging from 0 to 2,500 lb., temperature controls ranging from minus 30 to plus 450 deg. F., transformer relays and lever arm and float operating controls.

•

Circuit Breaker

The solenoid mechanism and breaker head of this new oil-blast circuit breaker are an integral unit, with internal operating linkage. It has been designed primarily for use in Type "RA" metal-clad switchgear and is complete with lifting ears, positive interlock bars, primary and secondary plug disconnectors.



"BR-30E," in 400- and 600-amp capacities at 7.5 kv., 800 amp. at 5 kv.; rupturing capacity, 25,000 kva.; also built for manual operation. **Delta-Star Electric Co.**, Chicago.

•

Ground Rod Hammer

Ground rod hammer. **Hubbard & Company**, Pittsburgh, Pa.

To secure high resistance to shock impact and corrosion, malleable iron castings are used in the vital parts of a recently marketed ground rod hammer which permits rapid driving of a ground rod to any desired depth by one man standing on the ground. This hammer is said to drive rods to proper depth without scoring or bending. In operation the rod is inserted into the chuck, secured and the hammer slid over the rod. Driving is done by striking the chuck body with the hammer, which fits over the wedges but does not strike them.

•

Solenoid Valve

Control of water supply to air conditioners and humidifiers is the function for which this new electric valve was designed. Operation of the valve is said to be unusually quiet since the plunger has a composition tip which closes the valve silently. The upper end of the plunger travel is silenced by a rubber pad. A novel scheme for attaching BX cable is another feature of this

Type H solenoid valve; connections may be for ⅛, ¼ or ⅜-in. pipe with orifices 1/16 or ⅛ in. diameter. **Supreme Electric Products Corp.**, Rochester, N. Y.

valve. The lower half of the coil housing is empty and the wires from the cable can be pushed into this space after connections are made with the leads. The housing connector holds the BX sheath in place.

•

Push-Button Station

Illuminated push-button station; white, green, blue, red, clear or amber buttons; unit is 2⅝ in. high, 1¼ in. wide, 2⅝ in. thick. **General Electric Co.**, Schenectady.

A small, standard-duty push-button station with an indicating lamp in the center of the translucent button is designed as a further aid to machine operators. The combination unit is said to need only about one-half the space required by push-button and indicating lamp when mounted separately. Lamp is operated through a small control transformer which may be mounted readily in or on a machine.

•

Coil Winding Machine

"Duo-Matic" coil winder; dimensions 76x36x60 in. **Universal Winding Company**, Boston, Mass.

Paper-insulated coils of any type or size up to 5 in. outside diameter, including Neon sign transformers, automotive ignition secondary windings, radio power amplifier transformer coils, controller coils etc., can be wound with a new winding machine now on the market. Operating from two separate rolls of insulating paper, with inserts automatically cut to length and injected between wire layers, this machine is capable of producing up to 28 windings simultaneously. Features include two-piece arbor construction, automatic stop motion for detection of wire breaks, oil-less bushings on all tension wheels, rubber-covered paper feed-roll, etc.

ENGINEERING DATA FROM MANUFACTURERS

Bulletins and catalogs now available to engineers by manufacturers and associations

IRRIGATION POWER—"Electric Power for Irrigation in Humid Regions" is the title of C.R.E.A. Bulletin, Vol. VII, No. 2. Spray irrigation, surface irrigation, porous hose and subsurface irrigation are systems discussed at some length. Included in a section on the electric motor are data on pumping costs. Copies are priced at 25 cents each and may be secured from the Committee on the Relation of Electricity to Agriculture, 1120 Garland building, Chicago.

MONEL PROPERTIES—Bulletin T-9, issued by the Development and Research Division, International Nickel Company, Inc., 67 Wall Street, New York, presents technical information on the engineering properties of "K" Monel. Mill working, heat treatment, shop working and applications are also discussed.

NEW N.E.M.A. STANDARD—N.E.M.A. Large Air Circuit Breaker Standards, Publication No. 37-43. National Electrical Manufacturers Association, 155 East 44th Street, New York. 75 cents a copy. This publication contains all the ampere ratings, voltage ratings, mountings, definitions, etc., that have been set up by the association for large circuit breakers. Supersedes the material in the switchgear standards, Publication 31-10, issued in 1931.

COMPRESSION GLAZE—Presents the results of subsequent research on this subject as carried out by the Locke Insulator Corporation, Baltimore, Md. Its three chapters discuss the advantages of compression glazed insulators, variation in mechanical strength of ceramic material and the effect of time and load on ceramic materials. Copies are available from the company.

LATHE OPERATION—Instructions on the care and operation of a back-geared screw-cutting precision lathe are presented in the 160 pages of "How to Run a Lathe," the 33d edition of which has recently been issued. The book is designed for the machinist apprentice and carries numerous drawings and photographs to make the discussion and explanations clearer. It is available from the South Bend Lathe Works, 435 East Madison Avenue, South Bend, Ind., at 25 cents for paper-bound, 75 cents for leather-bound copies.

"HEALTH PROTECTION OF WELDERS," issued by the Policyholders Service Bureau, Metropolitan Life Insurance Company, New York, outlines the possible hazards of welding on the health of welders and offers suggestions for their protection. Effects of gases, metal fumes, electric shock and burns and light and heat rays on the worker are discussed.

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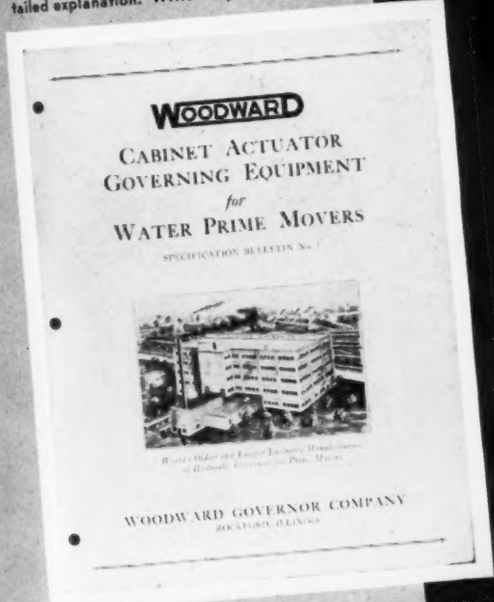
FOR COORDINATION INTO THE SYSTEM IS AN OUTSTANDING WOODWARD GOVERNOR FEATURE

Not only is a Woodward Governor exact and accurate for its immediate function of controlling the individual prime mover but it has the all important capacity for adjustment, so that its functioning can be relaed to other factors in the system which will affect its operation.

Entirely new in design, Woodward Cabinet Actuator Governors are built with the component parts consolidated to make possible less space requirements, less installation and maintenance cost, and a reduction in the regulating dead time. Because of its harmonious design and neatness a Woodward Governor can be located in the most strategic position from an operation standpoint. Location of the governor controls and indicators, as well as generator and turbine gauges, on the front panel of the Actuator add to the convenience of operation.

Woodward Cabinet Actuator Governing Equipment

A complete operating manual giving detailed instruction for the installation and operation of Cabinet Actuator Governing Equipment. Sectional views show typical construction of "Unit" and "Twin System" types, pressure tanks, restoring connections, etc., while 15 cuts and 25 halftone plates illustrate the detailed explanation. Write for your copy today.



Woodward Cabinet Actuator Governing Equipment for Water Prime Movers

A 28-page engineering manual containing a discussion of fundamental principles of governing; instructions for making preliminary calculations and description of both "Unit" and "Twin System" types of Cabinet Actuator Governing Equipment. Typical plant layout and arrangement drawings and sample specifications for actuator governing equipment are included. Copies available upon request.

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The world's largest governing unit, Woodward Cabinet Actuator Type, is installed at the Bonneville plant. The development of controllable characteristics by Woodward is most fully advanced in this Governor. Bonneville will realize advantages never before possible because of the design which insures a highly sensitive and rapidly responsive governor.

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Highway makes a complete line of truck bodies for Central Station line construction and service trucks. These bodies serve the widest range of utility needs—each type is designed to be light of weight yet ruggedness is built in—each type offers the utmost in convenience. These bodies are economically adaptable to today's requirements. Highway bodies have dependably served utility construction and maintenance needs for years.

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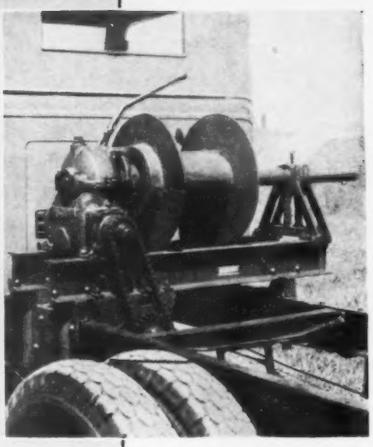
Designed for low-cost service, there is a Highway Winch for every need with types light enough to use on 1½- and 2-ton trucks. Highway Winches are lighter and more durable, easier to use and stay in service without costly maintenance requirements. They are built with the same precision that characterizes the best in automotive equipment. Exceptionally large size housings enclosing the winch worms and worm wheels permit the use of a generous supply of oil which keeps the working parts moderately cool under the most severe working conditions.



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Pasadena Analyzes Gains From Frequency Change

[*Continued from page 61*]

higher frequency. Only that portion which did not operate satisfactorily was adjusted. No attempt was made to adjust residential equipment before the change, this work being done upon telephone complaint from the customer. Clocks were the principal concern and were handled by bringing them into a central depot for adjustment by private contractors at no cost to the customer.

The frequency change permitted, at the same time, the raising of voltage

Table III—Capitalized Value of Cycle Change

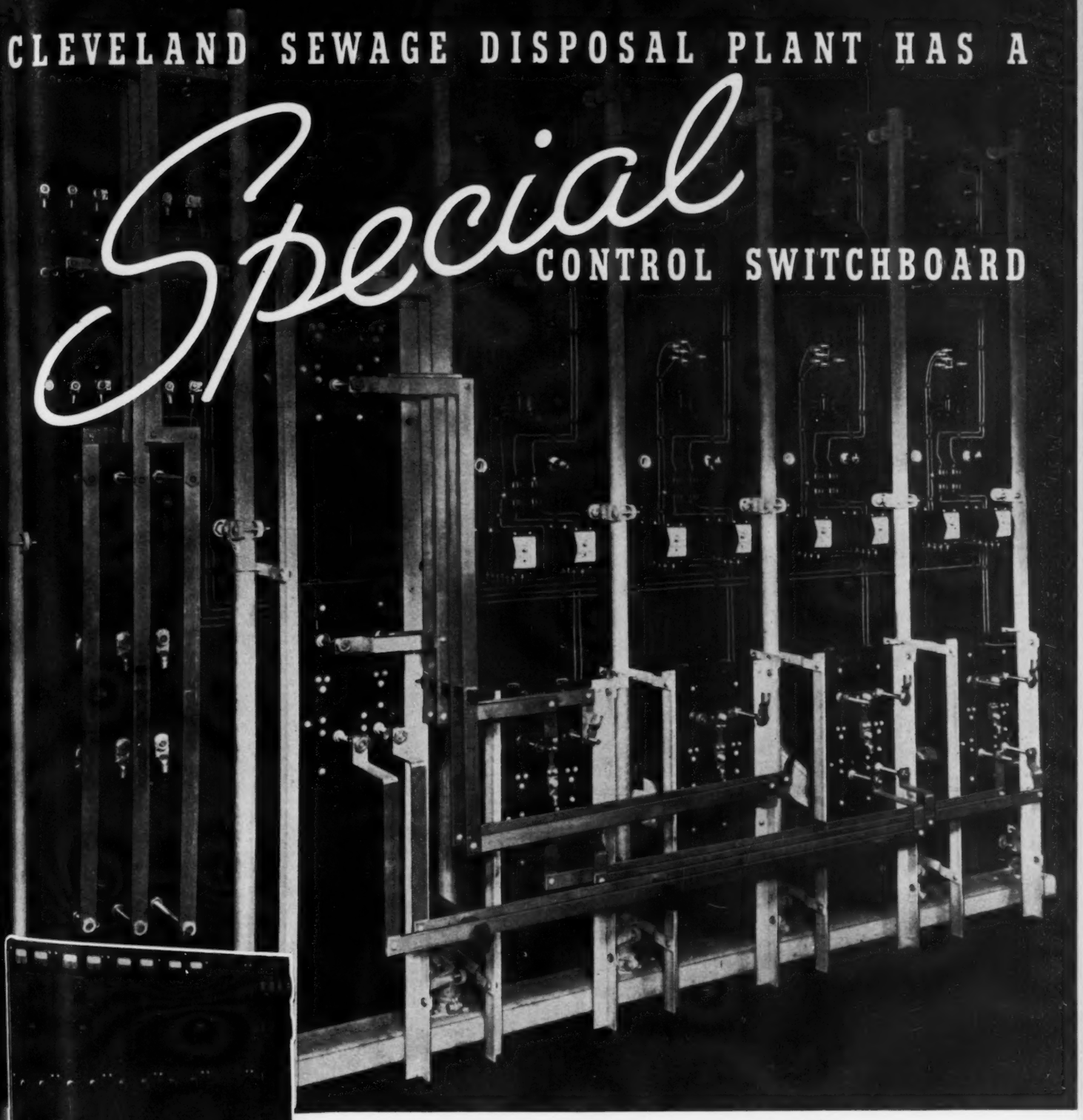
(a) Increase in distribution system capacity		
Portion of distribution capital affected by frequency change	$1,469,680	
60-cycle distribution capacity increase due to increase in voltage and power factor		
$\frac{120}{115} \times \frac{87}{82} = 110.445\%$		
Added value 10.445% of $1,469,680		$153,500
(b) Savings in losses over 20-year period based on 80,000,000 kw.-hr. annual generation 2,552,000 kw.=hr. at $0.004 = $10,208 annually. Present worth 13.59 × $10,208		139,900
(c) Savings in future equipment purchases because of 30 cents per kva. lesser cost for standard 60-cycle apparatus — 25,000 kva. of substation transformers, etc. 25,000 kva. × 30 cents		7,500
(d) Savings in purchase of distribution transformers at $1.00 per kva. for 2,500 kva. per year — 20-year basis Present worth 13.59 × $2,500		34,000
Total gain		$334,900

Cost of Frequency Change

The complete cost of frequency change cannot be given because a small amount of work is still in progress. The cost up to February 1 is as follows:

(a) Office work	$25,707.58	
(b) Field and shop work	27,489.15	
(c) Adjusting small equipment (by contract)	69,332.83	
(d) Adjusting consumers' power equipment	57,226.08	
(e) Cal. Tech. changeover (estimated total)	16,295.88	
(f) Power plant changeover	17,021.17	
Total	$213,072.69	
(g) Estimated cost to complete frequency change 10 per cent of 213,072	21,307.31	
Total cost		$234,380
Net gain due to change		$100,520

CLEVELAND SEWAGE DISPOSAL PLANT HAS A *Special* CONTROL SWITCHBOARD



George B. Gascoigne & Associates, Consulting Sanitary Engineers, Cleveland, New York

● For control of motor generator sets which operate traveling bridges used for breaking up sludge in the magnetite filter beds, the construction engineers of the new sewage disposal plant in Cleveland, Ohio required a special switchboard of unusual specifications—and we built it to meet their rigid requirements. The same precision and care used in construction of our standard **TRIPLE S** and NTP roller contact panel boards is put into this special job for special purposes.

Correct design, good engineering, skilled workmanship and the finest materials—that is the formula we have used for nearly 40 years in building electrical power and lighting panels. Simple, rugged construction—versatility in meeting unusual requirements—these features of our service are well known. If you plan to modernize or enlarge your power or lighting circuits, familiarize yourself with the advantages offered by **TRIPLE S** power panels and NTP roller contact lighting panels. For special requirements write us about your problem. New specification manual sent on request.

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» » COMPANY « «

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Burndy Connectors combine rugged strength with compactness, high conductivity and speedy installation. This ideal combination is the result of precision in design, manufacture and testing.

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Right: End Connector — Type FE — for joining tubing or cable to any size or combination of flat bar. Contact surfaces finished to minimize resistance.

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from 115 to 120 volts as a result of greatly reduced core losses at the higher frequency. This loss dropped 16 per cent at 60 cycles and permitted raising the voltage 4.3 per cent. At the same time the average system power factor moved from 72 to 80 per cent, with peak power factors going up from 82 to 87 per cent. This added an appreciable saving in copper losses. The resulting system efficiency increased from 86.4 per cent to 89.2 per cent as a result of these changes, an analysis of which is shown in Table II. In this table the 50-cycle values from Sept. 1936 to Feb. 1937 are calculated.

Capitalizing these figures, as shown in Table III, indicates that appreciable monetary savings can be credited to the frequency change. The relationships are depicted graphically in the accompanying illustration. In analysis the distribution savings would have justified the changeover. On a twenty-year basis the savings in copper and core losses alone would have paid for half the cost. Experience with the system operation at 60 cycles convinces the engineers of the city that the proposal to bring Boulder power in at 60 cycles was well justified by the saving it made possible to the operating systems and the convenience and savings it brings to the customer in making standard equipment available for use in the area.

•

Obtains Release of $625,683

Gulf States Utilities Company has notified the New York Stock Exchange that it has obtained the release of $625,683 of the $1,000,000 deposited with the Chase National Bank as trustee under an indenture securing its first-mortgage and refunding bonds, Series C, 4 per cent, due in 1966, against certification of an equal amount of additional property. The balance on deposit with the trustee is now $149,662.

•

100,000 Visit Electric Home

Visitors to the Commonwealth Edison Company's Golden Anniversary Electric Home in Englewood reached a total of 100,000 on August 25. The home opened on June 1. Forty-one states and six foreign countries are represented on the visitors' register. The home is air-conditioned and contains the most modern electrical household devices.

Look into the Industrial Future

NEW INTERNATIONAL AMPHITHEATRE CHICAGO OCTOBER 4-9, 1937

See how Industrial Progress *Is keeping Pace with Father Time*

Today's vast industrial expansion is crowding out of use the so-called new methods of yesterday—demanding newer, more efficient ways of generating and using electrical energy.

Applications of power and engineering that satisfied the needs of past years fail to meet the requirements of today. There's nothing mystic about it—it's just the evolution of engineering progress keeping up with Father Time.

See the new developments already here and foresee what's coming in the engineering world. Be a factor in their application as a solution to the problems that face you. Visit the Chicago Exposition of Power and Mechanical Engineering, October 4 to 9 this year.

Every man charged with the responsibility of knowing the newest and best equipment, materials, supplies, instruments and tools for generating, transmitting, measuring, controlling and applying power will be well repaid by a study of the educational opportunities offered at this great Chicago Exposition.

See to it that your associates come too, and send your engineers. They, as well as you, will return with ideas that can be used profitably. Take a look into the future by seeing the

CHICAGO EXPOSITION OF POWER AND MECHANICAL ENGINEERING

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Same Management and Standards as the National Exposition of Power and Mechanical Engineering Held Every Other Year in New York.

THE NUT RETAINER *is a* PATENTED CHANCE FEATURE

AIDS INSTALLATION AND SAVES RODS

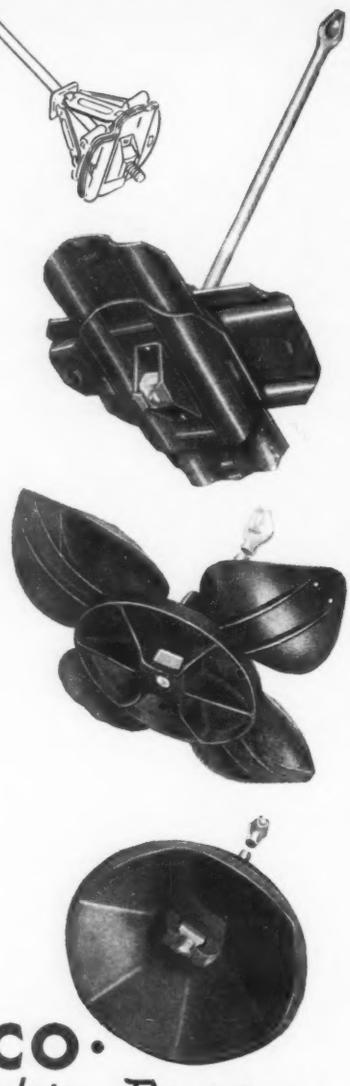
The nut retainer or nut housing originated and patented by the A. B. Chance Company, pays benefits in making expanding or cone anchor installations. The nut retainer makes it possible to push the anchor down into the hole without danger of it catching on the sides and riding up the rod.

With the nut retainer there is no need for boring a larger hole than the rated size of the anchor in order to get a satisfactory installation. The larger the hole the less holding power in undisturbed earth. To get maximum efficiency use anchors with nut retainers and keep the hole to the minimum requirements.

The Chance nut retainer allows the rod to extend through the bottom. The rod may be screwed down the full length of the thread if necessary. The nut retainer makes it possible to salvage the rod or rod can be driven through retainer and into the ground.

It pays to buy, use or specify expanding or cone anchors with the Chance nut retainer. Consult your new Chance catalog for anchors with this patented Chance feature.

You'll find it on the Chance Steel Two-Way and Four-Way, the Wej-Lock Two-Way, Three-Way, and Four-Way, and the Chance Pyramid Cone Anchor.



A·B·CHANCE CO. *Utilities Division*

CENTRALIA MISSOURI

Case History of a Water-Heating Group

[*Continued from page 67*]

breakdown of seasonal usage by size of family appears in Table VII for families which use no furnace coil and in Table VIII for families which do use such coils.

Perhaps it will be of interest to notice in Table IX that the customer who uses his furnace coils to supplement electric water heating saves only 71 cents per month, or about $8.52 per year. The difference in cost reduces down to about ½ cent per person per day.

One of the more useful tools derived from this study may be noted in Table X. With these data, based upon non-coil-using customers, we are able to secure constants for gallons heated

Table XII—Gallons of Hot Water per Person per Day

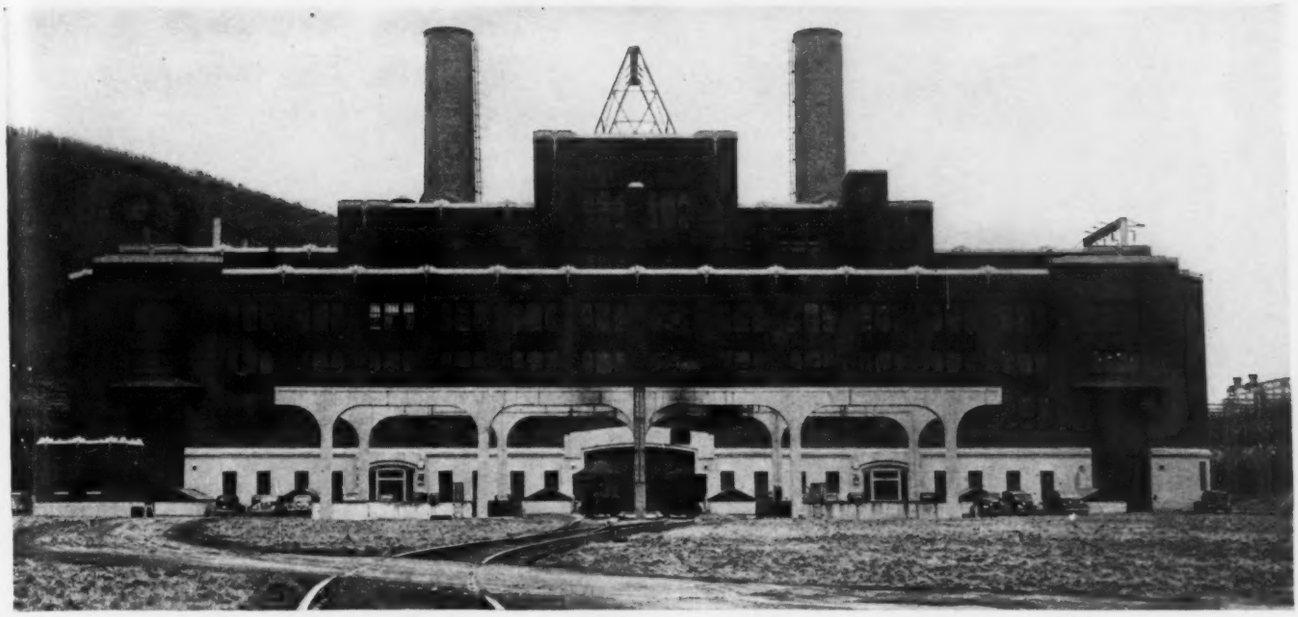
No. in Family	Gals. of Hot Water per Person per Day: Average Minimum	Average Maximum	Over-all Average
2	12.4	18.5	15.3
3	9.7	14.6	11.7
4	7.7	12.4	9.6
5	8.3	11.7	9.8
6	7.4	11.5	9.3
7	7.7	11.1	8.9
8	8.3	12.8	9.6
Average	8.4	12.5	10.4

There is always the question as to the average use of hot water per person per day. From Table XI, we can get accurate figures for various months of the year. In most cases the maximum is used in June and the minimum in January. As might be expected, the small size family uses more per person than the large family. The over-all average shows 15.3 gal. per person for two in the family down to approximately 9 gal. per person for the larger families. The over-all average for all customers of 10.4 gal. is, of course, very close to the accepted 10-gal. figure.

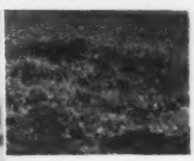
Table XIII—Water Heater Installations per Month for 1935 and 1936

	No. Units 1935	No. Units 1936	Per Cent of Total, Year 1936
January	....	17	2.5
February	13	23	3.5
March	33	47	6.9
April	36	73	10.7
May	59	126	18.6
June	49	73	10.7
July	49	106	15.6
August	33	60	8.8
September	39	41	6.0
October	28	37	5.5
November	19	42	6.2
December	19	34	5.0
Total	377	679	100.0

While some few heaters had been installed on an experimental basis before March, 1935, the actual introduction of heaters was started at that time. We find that during 1935, 377 heaters were installed, while for the year 1936, 679 was the figure. This shows the very satisfactory increase of 80.1 per cent.



These Exides Have Three Important Functions



In this 95,000 k.w. station

Exide

BATTERIES

assure power for Control, Valve Operation and Emergency Lighting in plant.

Above: 120-cell Exide Battery, 592 amp. hr. capacity, for valve control and emergency lighting; below it is the 120-cell Exide, 320 amp. hr. capacity, used for control bus service.

FROM the Stanton Plant, located near Pittston, Pa., and jointly owned by The Scranton Electric Company, of the American Gas and Electric Company group, and by The Pennsylvania Power and Light Company, comes power which these companies distribute to their customers in Carbondale, Scranton, Wilkes-Barre and numerous other cities in that vicinity. Two units, rated at 47,500 k.w. each, give this plant a capacity of 95,000 k.w.

In view of the importance of this station, it is not surprising that two dependable 120-cell Exide Batteries are used for the protection of its equipment.

One of these batteries is used exclusively for control bus service. The other is used for valve control in both normal and emergency operation, while, in the event of a power failure, this battery would also provide emergency lighting within the plant.

It is significant how many of the finest equipped power plants in the country use Exide Batteries for control bus, as well as for numerous other stationary services peculiar to modern power plant practice. Write us if you have a problem that storage batteries may solve. There's no obligation.

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The World's Largest Manufacturers of Storage Batteries for Every Purpose
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STERLING CRANKLESS DIESEL ENGINES

built under
"MICHELL CRANKLESS ENGINE"
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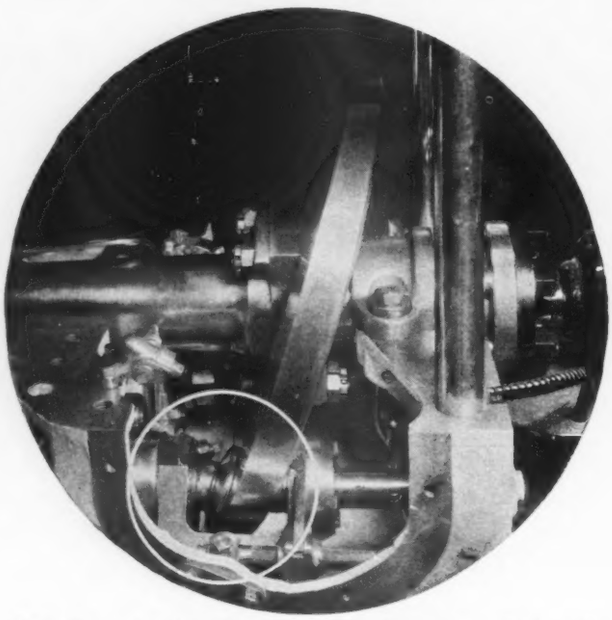
Quotation of report after 7 months of continuous running:

"Micrometer readings of bridge bushings, pistons and cylinders gave no evidence of wear, these measurements showing the same as the new parts with which I compared them. Apparently this is due to the absence of side thrust on the cylinders, and the fact that these engines burn the fuel oil cleanly.

"The longer I have these engines the more I am convinced that I could not have installed a better engine than STERLING. My experience in removing the piston for inspection and replacing it convinced me more than ever that the Sterling Company has gone a long way toward simplifying maintenance."



The slipper bearing, Michell or Kingsbury type, which makes possible the transmission of power from piston to shaft, eliminating a crankshaft and its multiplicity of bearings.

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per kilowatt-hour for varying city water temperatures and thus estimate with greater accuracy the usage of hot water and electric service.

Finally, our investigation shows, as detailed in Table XII, that a family of two persons uses 15.3 gal. of hot water per day; that use per person diminishes as the size of family increases, until a figure of 9.6 gal. of hot water per day is reached in families of eight persons. Our over-all average of about 10.4 gal. per person per day is very close to the generally accepted figure of 10 gal.

•

To Enlarge Municipal Unit

A. J. Frank, superintendent of the Abbeville (La.) water and light plant, has been authorized by the town Council to draw the advertisement for bids on a new power unit of 1,000 hp., estimated to cost between $50,000 and $60,000. Mr. Frank says that the present installation is inadequate. Power house quarters are to be enlarged to house the bigger unit, Mr. Frank said.

•

Co-op to Request New Loan

Kentucky Public Service Commission has authorized the Shelby Rural Electric Co-operative Corporation to borrow an additional $100,000 from the government. The money will be used to extend its transmission lines in Shelby and Oldham counties. The co-operative had previously borrowed $100,000.

•

REA Customers Protest Rates

South Carolina Rural Electrification Authority heard complaints recently from a group of REA customers in Aiken County that its rates were too high. A committee was appointed to investigate the protest. A. J. Beattie, secretary of the authority, stated the complaint came from customers who asked that an existing service be extended to serve them and that the REA agreed to do this, but required the higher rate because of additional expense.

The authority, Mr. Beattie said, discussed the delay in getting another 300 miles of lines approved by the national authority and took action calling on the officials to speed the approval. These new lines would serve 1,142 customers.

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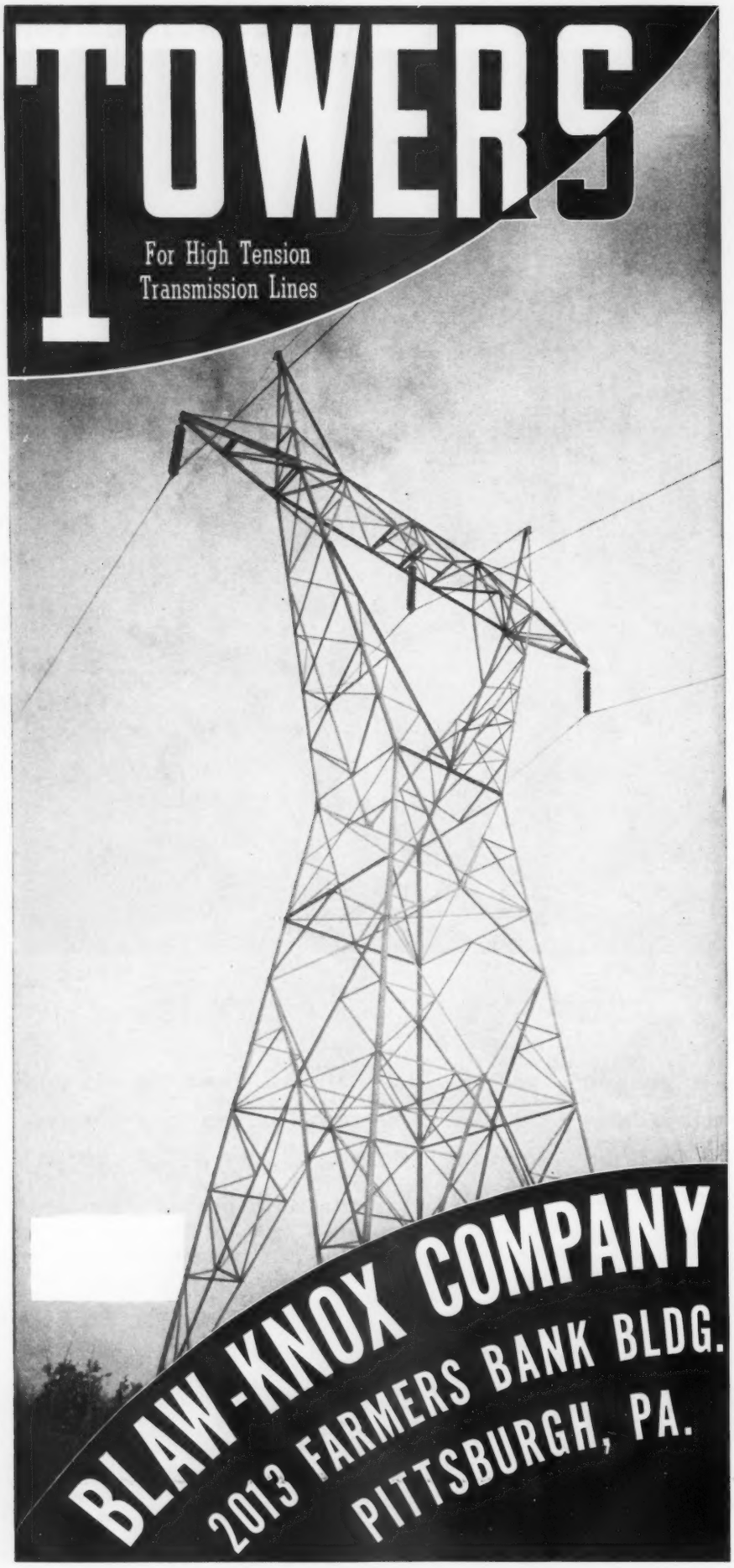


Converter Model Used to Train Operators

[*Continued from page 68*]

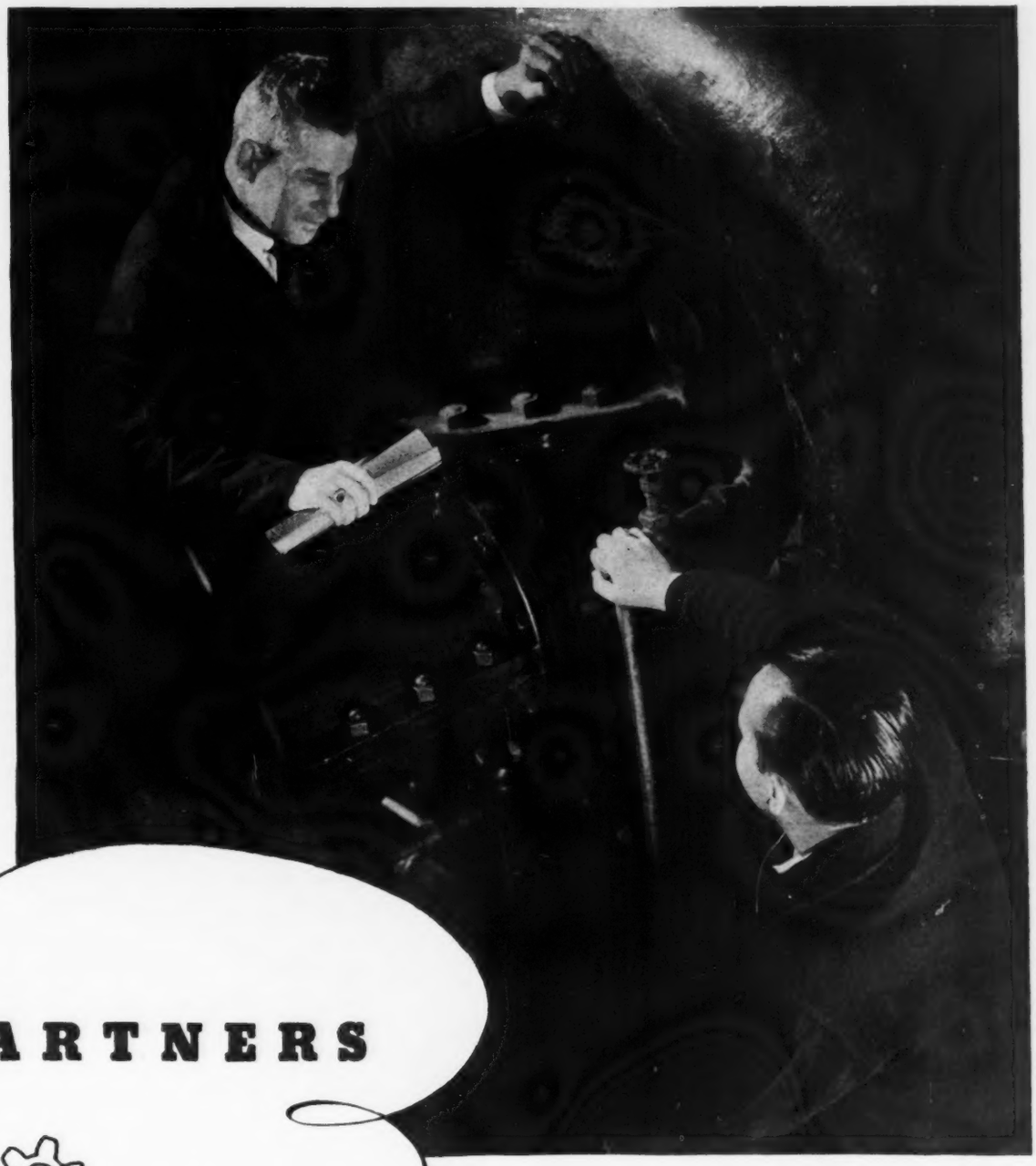
tem, completing the placing of the converter in operation.

Assume that a converter has been started from the 60-cycle side, instead of the 25-cycle side, and is up to speed and synchronism on the 60-cycle bus with the synchroscope and rotors at the 0 position. When a 60-cycle pole is slipped the 60-cycle pointer would move 180 deg. in the slow direction and the 25-cycle pointer will move 180 deg. divided by 2.4 or 75 deg. If more poles are slipped, it will be found that the 25-cycle pointer will never stop at the 0 position until 23 more poles have been slipped. However, it will be observed that after slipping 11 poles (when pole 12 is at the 0 position) the 25-cycle pointer points directly downward to 180 deg. Therefore, if the 25-cycle field should be reversed the 25-cycle rotor will be in synchronism. Thus by having means for reversing fields on the 25-cycle machine the number of poles that must be slipped will be less than half as many.

Surrounding the 25-cycle frame shift ring in the accompanying illustration will be noted a series of numbers adjacent to certain degree marks. The purpose of these numbers is to tell the operator how many poles remain to be slipped at any time to obtain synchronism on both machines. For example, in the last paragraph, when the first 60-cycle pole was slipped, the 25-cycle pointer stopped at 75 deg. on the slow side and just opposite 75 deg. appears the number 23. This means that 23 poles remained to be slipped on the 60-cycle side to bring the 25-cycle side into synchronism.

Assume again that the machine has been started on the 60-cycle side and is up to speed and synchronism with that bus, and that the 25-cycle synchroscope is standing at 75 deg. on the slow side, 23 poles remain to be slipped. The operator slips 4 poles, bringing the 25-cycle pointer to 15 deg. on the slow side. The machine is now 15 electrical degrees out of synchronism and can be brought into synchronism by shifting the frame and avoiding 19 more pole slips.

In some cases, instead of slipping one pole at a time as previously described, it is the practice to open the main oil circuit breakers on the start-



PARTNERS

HERE is a familiar scene in America's power plants today—the Gulf lubrication engineer working in cooperation with the power plant engineer.

Both have a definite objective: To get the most efficient lubrication possible for every prime mover and auxiliary unit in the plant. So they "team up," pool their knowledge and experience in a united effort to defeat friction.

The Gulf engineer is well fitted to carry on this cooperative work. His entire time is spent in gaining and applying knowledge of oils and greases—to the end that engines and machines may operate more efficiently and economically. He works with the plant engineer, recommending the use of lubricants exactly suited to each moving part and suggesting the best methods of application. Such careful attention to lubrication pays a generous reward in lowered costs for maintenance and in continuous, trouble-free operation.

The Gulf line includes more than 400 quality oils and greases. The combination of this quality line of lubricants and Gulf's engineering counsel can help *you* attain maximum efficiency for *your* equipment.

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A CROSSETT WATZEK GATES INDUSTRY

JACKSON LUMBER COMPANY POLES DIXIE PILING LOCKHART, ALABAMA

ing machine and allow the machine to slow down until the 25-cycle synchroscope indicates that 2 poles have been slipped on the 60-cycle side, whereupon the 60-cycle oil breaker can again be closed. This method, though risky, will take half as many operations as the other method. Markings on the 25-cycle synchroscope in the accompanying illustration are for this practice. The figures opposite the degree marks here represent the pairs of poles that must be slipped on the 60-cycle side to obtain synchronism.

Several other converter operating methods can also be explained with the model.

•

Recent Rate Changes

DUQUESNE LIGHT COMPANY'S customers were promised annual savings of $1,276,000 when the Pennsylvania Public Utility Commission announced at Harrisburg a temporary rate structure. Several weeks ago the utility board ordered the company to reduce its rates to result in $1,250,000 annual reduction in revenue.

KANSAS CITY POWER & LIGHT COMPANY has been ordered by the Missouri Public Service Commission to put into effect reduced electric rates for smaller commercial users.

MILWAUKEE ELECTRIC RAILWAY & LIGHT COMPANY has been authorized by the Wisconsin Public Service Commission to make an annual electric rate reduction of from $153,000 to $203,000 for residential and commercial customers, effective after September meter readings. The reduction, which is the third this year, will benefit users of more than 50 kw.-hr. a month and will vary according to the amount of electricity used between 50 and 100 kw.-hr. The decrease provides for a minimum annual reduction of $153,000, including a reduction of $50,000 annually in residential rates. Under the "10 to 1" plan, residential and commercial users can benefit at a maximum reduction of $203,000.

WEST COAST POWER COMPANY has announced "bargain sale" electricity rates to encourage greater use of power in reducing its rates $7,000 a year to Cathlamet, Ilwaco and rural South Bend customers. All these communities are in the State of Washington.

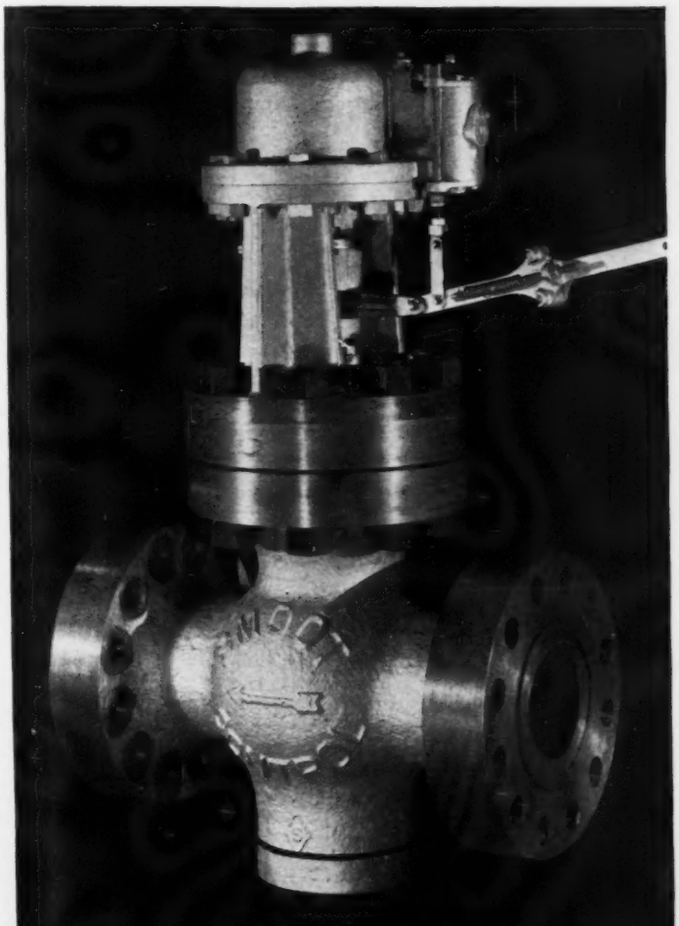
WEST TEXAS UTILITIES COMPANY has announced a reduction of 17 per cent in its electric rate in 21 towns in West Texas to consumers using electric cooking ranges. The rate was cut from 3 cents to $2\frac{1}{2}$ cents per kilowatt-hour on all over 50 kw.-hr. used monthly and it will apply to all electrical usage, over that limit—lights, refrigeration and small appliances—in homes equipped with the electric range.

POTOMAC EDISON COMPANY has made another downward revision in its rates following a series of conferences between members of the Maryland Public Service Commission and company officials. Under a new schedule filed with the commission consumers will save approximately $95,000 a year. In discussing the reduction, R. Paul Smith, president, stated that the reduction not only applies to domestic users, but also provides substantial reductions for commercial and rural patrons.

SMOOT
FEED WATER CONTROL

THE STANDARD FOR MODERN BOILERS

★



SMOOT TURBINE TYPE VALVES

One of the three 3½-in., 1,500 lbs. Smoot Turbine Type Valves recently installed at the West End Station, Cincinnati Gas and Electric Co., to regulate the flow of feedwater to each of three 350,000 lbs. per hr. boilers operating at 1,200 lbs. steam pressure.

★

RECENT INSTALLATIONS

★

WEST END STATION. Boiler Water Level and Excess Pressure Pump Control for three 350,000 lbs. per hr., boilers operating at 1,200 lbs. steam Pressure.

MILLER'S FORD STATION. Boiler Water Level Control for two 375,000 lbs. per hr., boilers operating at 1,250 lbs. steam pressure.

NORTHEAST STATION. Boiler Water Level Control for one 350,000 lbs. per hr., boiler operating at 1,200 lbs. steam pressure.

OMAHA STEAM PLANT. Boiler Water Level Control for one 300,000 lbs. per hr., boiler operating at 1,200 lbs. steam pressure.

LOGAN STATION. Boiler Water Level and Pump Control for one 1,000,000 lbs. per hr., boiler operating at 1,325 lbs. steam pressure.

FISK STREET STATION. Boiler Water Level, Excess Pressure Pump Control for two 412,500 lbs. per hr., boilers operating at 1,275 lbs. steam pressure.

SPRINGDALE STATION. Boiler Water Level and Pump Control for three 500,000 lbs. per hr., boilers operating at 1,250 lbs. steam pressure.

WATERSIDE STATION. Boiler Water Level Control for four 500,000 lbs. per hr., boilers operating at 1,250 lbs. steam pressure.

STATE LINE STATION. Excess Pressure Pump Control for two 550,000 lbs. per hr., boilers operating at 1,200 lbs. steam pressure.

COMPLETE DATA MAILED UPON REQUEST

REPUBLIC FLOW METERS CO.

2228 DIVERSEY PARKWAY **CHICAGO, ILL.**

INSULATION HEADQUARTERS

SET US ON THE TRAIL

Your insulating problems, whether electrical, thermal or mechanical, can probably be solved with one of our insulating materials—if you will set us on the trail. Our laboratory department with its staff of experienced technicians will gladly study your problems and suggest solutions.

Continental-Diamond insulating materials provide a wide range of mechanical and electrical properties and costs. One of them will undoubtedly fit into each of your specific problems. They will also help you to improve product performance or appearance, to prolong operating life, to reduce production costs, and to speed up manufacturing schedules.

CONTINENTAL-DIAMOND FIBRE CO.

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DILECTO

A laminated plastic, commonly known as phenol fibre, made in sheets, rods and tubes or fabricated parts to specifications. Has high electrical insulation properties, great resistance to water, practically unaffected by oil or mild acids. It is a strong, tough material with a wide application for use in connection with modern electrical appliances.

DIAMOND VULCANIZED FIBRE

A tough, economical, insulating material made in standard sheets, rods and tubes. Can be readily fabricated or formed. A material of countless applications.

VULCOID

A thermo-plastic, non-hygroscopic insulating material made in standard sheets, rods and tubes. It is strong and tough, has good electrical insulating properties and is readily fabricated.

MICABOND

Thin splittings of mica bonded together with specially developed binders into standard plates, tubing or in formed rings, punched and sawed segments or other special parts. Micabond has high dielectric strength, is practically unaffected by acids, has high heat and moisture resistance, is readily punched, sawed or formed.

CELLULAK*

A laminated form of insulating tubing, possessing extremely high dielectric properties, and marked resistance to flash-over.

DILOPHANE

A translucent, laminated plastic in colors. It provides perfect light diffusion, is not inflammable, and is manufactured in practically any color imaginable with either a glossy or dull finish.

Quick Test Method for Instrument Transformers

[*Continued from page 79*]

on the test meters is entirely up to the engineer in charge of testing. However, there is a point at which the time consumed in increased revolutions is not compensated for in terms of increased accuracy. For commercial accuracies of 0.1 of 1 per cent in ratio it was found that the following table would suffice, if the meters were read to one-fourth of a division at the slower speeds, and were not further apart than one-half of 1 per cent at the points used:

Potential Transformers	Revs.
Unity P. F.	40
50 per cent P. F.	20
Current Transformers	
Unity P. F. full load	40
50 per cent P. F. full load	20
Unity P. F. light load	10
50 per cent P. F. light load	5

The time required to test a potential transformer using the above revolutions and a meter with a constant of one-third is about three minutes, and that of a current transformer about twelve to fifteen. This time may be materially cut by using meters with a constant of one-fourth, without endangering the accuracy of the test. If the constants are changed, however, both meters should be of the same make and type, so that any characteristic change that might result would be common to both of them.

The accuracy of this method is very high, as may be seen in the following table. This table consists of tests made on a current transformer by an absolute method, two portable test sets and the two test meters:

Method	Per Cent Ratio	Min. of Angle
	Full Load	
Mfrs. curve (Absolute)	99.7	+9
No. 1 Silsbee set	99.72	+8
No. 2 Silsbee set	99.71	+10
Meter method	99.7	+8
	Light Load	
Mfrs. curve (Absolute)	100.0	+18
No. 1 Silsbee set	99.85	+15
No. 2 Silsbee set	99.75	+19
Meter method	99.95	+18

The values listed in the chart are not, strictly speaking, linear quantities, although they are represented as such. However, the error introduced by such representation is negligible within the chart limits, being in the order of plus or minus two minutes of angle at the extremes. The value of each square on the chart is one minute of angle, or 0.05 of 1 per cent at 50 per cent power factor, and this is the limit to which the chart may be read. The addition of the meter revolutions, rather than extracting the square root of the ratio

An Innovation for Rural Lines

SILO TYPE SUBSTATION

Much has been accomplished in cities by architectural design of substations to blend with surrounding buildings.

The Cazenovia Electric Company, Cazenovia, N. Y., has carried this note into substation design for Rural Service. The SILO TYPE substation is the result.

ELPECO is pleased to present this innovation since it was privileged to work with the engineers to see that the equipment as well as the building would exemplify modernized switching.

DETAILS

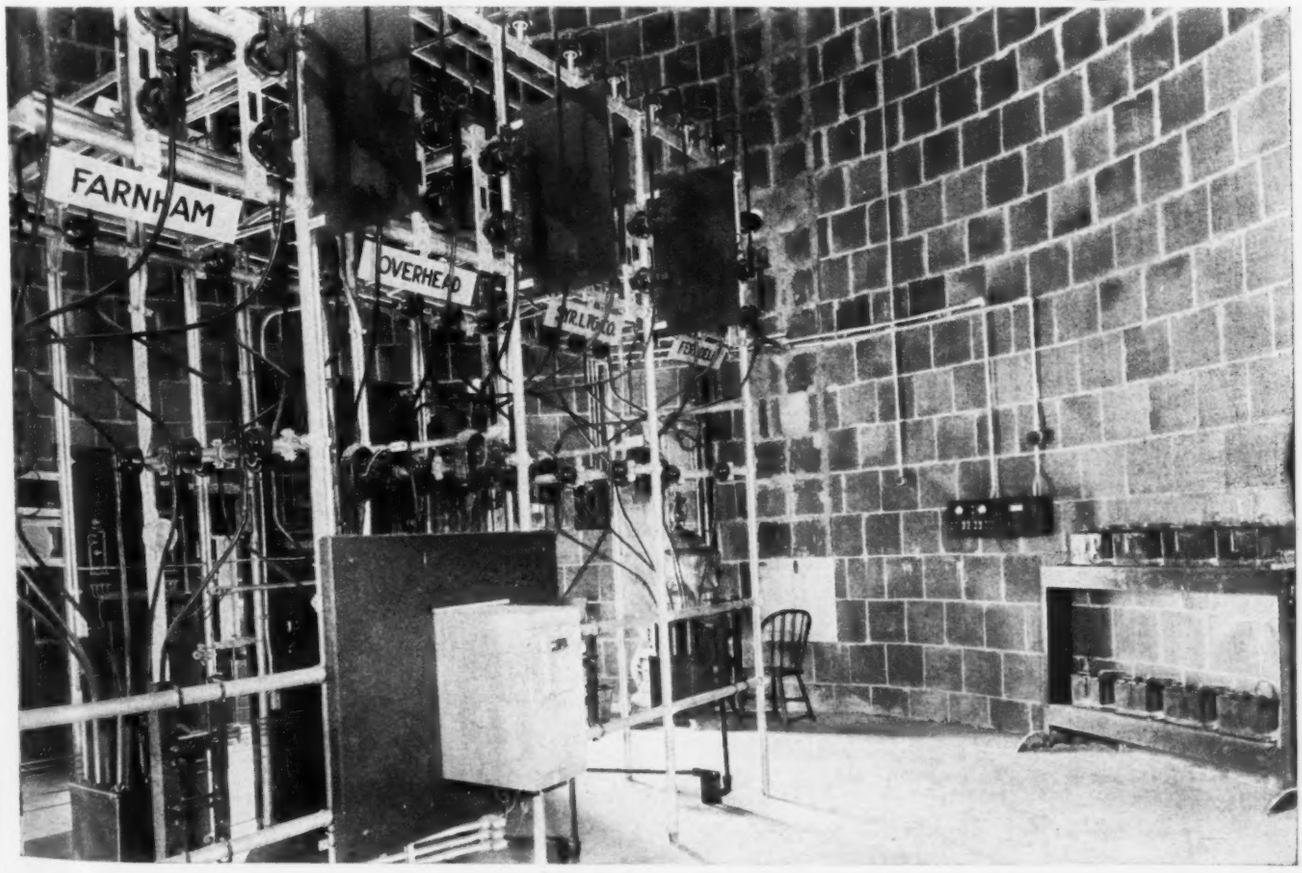
Switching Station only—2 incoming feeders and 3 outgoing 200 amps., 2300 volts, 3 phase. Silo dimension 30 ft. diameter, 30 ft. high. In operation since April, 1936—"very satisfactory service," they write.

ELPECO cooperation is always at the call of engineers in combining engineering with equipment "for the Good of the Service".

PIPE FITTINGS
BUS SUPPORTS
DISCONNECTS

BY

ELECTRIC POWER EQUIPMENT CORPORATION
ELPECO
PHILADELPHIA, PA.

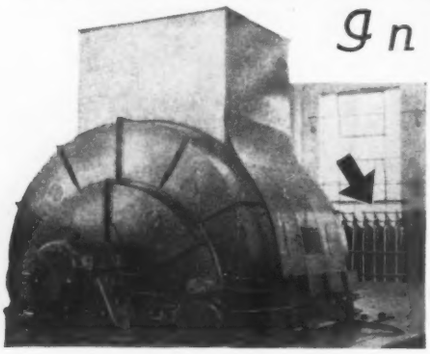


ELECTRIC POWER EQUIPMENT CORPORATION

412 North 18th St. **Philadelphia, Pa.**

SERIES IN WHICH SOME OF THE
GREAT PUBLIC UTILITIES TELL HOW LUX MEANS "UNINTERRUPTED SERVICE"

POWER STAYS ON THE LINE
In Alabama



(Above)—Condenser at Anniston Primary Sub-Station. Note LUX cylinders in the rear.

(At top)—Mitchell Dam Development of Alabama Power Company

THE Alabama Power Company—organized in 1911 and today serving 10,000 circuit miles—employs excellent safety practices which contribute to its fine service record and low fire losses. A large number of LUX portables as well as automatic systems guard extensive investments in Primary Sub-stations, Generating Stations, Switch Board Rooms and Garages against damage.

The Gorgas No. 2 Steam Plant. A reserve unit called on for 80,000 H.P. in case of low water flow in hydro plants.

Protective Value of LUX SYSTEM *recently demonstrated*

Recently, a bolt holding the lead clamp on one of their synchronous motors broke and was thrown into the stator windings, short circuiting some of the coils. The resultant operation of the machine differential relays caused the LUX System to function. The entire machine was flooded with LUX gas, damage confined to the affected coils and serious fire damage or possible total loss of the machine definitely prevented.

Employing the dry harmless gas—carbon dioxide—LUX systems swing into action at the first flash of heat and three seconds later fire cannot exist. Yet the cost of LUX systems is often less than ½ of 1% of the value of protected equipment.

Let our engineering staff survey your requirements and submit recommendations.

• • • •

Write for your copies of two booklets just off the press describing how and where "LUX Makes the Difference" by smothering fire in Power Plants in hundreds of great Public Utility projects.

Walter Kidde & Company, Inc.
30 West St., Bloomfield, N. J.

FOR ALL ELECTRICAL AND FLAMMABLE LIQUID FIRES

of their products, also produces an error, but it is negligible, being about 0.05 of 1 per cent for errors greater than 5 per cent in ratio, which can be ignored in commercial work. Therefore it is safe to say that within the limits of the chart—that is, three degrees of angle and 5 per cent in ratio—the accuracy of this modern, quick method is better than 0.1 of 1 per cent, which is entirely satisfactory for the purposes intended.

•

Municipal Plants

STANTON, IOWA—In a spirited election held August 24 citizens voted to erect a municipal electric system at a cost not to exceed $24,000 to be paid for out of the earnings of the system. Young and Stanley, engineers, of Muscatine, who made a preliminary survey prior to the election, will now make detailed plans and bids will be asked. Iowa-Nebraska Light & Power Company has been serving the city.

FOREST CITY, IOWA—Interstate Power Company has been given two decisions in its favor over the municipality by Judge T. A. Beardmore of the district court. Mayor M. J. Wolfs has been ordered to call a special election on a proposal to grant the power company a franchise. The other decision grants an injunction against the construction of a municipal light plant that was voted by the city on the grounds that the contracts for it do not comply with state laws.

STORM LAKE, IOWA—In a special municipal election held August 25 the proposal to build a municipal electric plant was turned down by a vote of 1,119 against and 1,052 for the proposal. It was a surprising reversal of the vote of the special election held on April 14 when the Iowa Public Service Company was denied a four-year extension of its franchise by a majority of 407 votes. Fourteen more votes were cast than in the April election. In April every ward in the city went against the granting of the franchise and in the present election, only one ward favored the municipal plant. Iowa Public Service Company's franchise expires August 25, 1938.

GOODLAND, KAN.—Citizens Utility Company has lost a district court battle recently to prevent the city from building its own electric light and power system. Residents voted approval of municipal ownership last February and authorized issuance of $200,000 in municipal bonds for a city plant. The private utility company challenged legality of the election and sought to block the construction of the municipal power and light plant.

SOMERSET, KY.—Action was delayed on a movement to establish a municipal light and power plant when city council defeated a motion authorizing a survey to ascertain cost of the proposed project.

SANDUSKY, OHIO—City officials face the necessity of involved legal routine in a $1,400,000 bond issue for a municipal light plant. Voters on August 17 defeated by 2,396 to 1,276 a proposed city charter amendment which would have empowered city officials to issue bonds on preliminary plans only. Without the amendment, the charter stipulates that bond issues cannot

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...The most economical and convenient type of insulation for armature slots...Supplied in sheets or strips or cut to slot sizes...It saves both labor and material and simplifies the winding job.

IRV-O-SLOT...Is a varnished cambric insulation duplexed with any standard thickness of fibrous insulation. The materials are cemented with a flexible binder that permits shaping without separation of the layers.

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Specialized Engineered UNITS FOR EVERY LOCALIZED LIGHTING NEED ★

NEW FLEXIBLE fostoria LOCALITE SEWING MACHINE LIGHTING UNIT

Regardless of line voltage this new Localite unit may be applied without alteration. It accommodates any double contact candelabra bayonet base lamp 2¾" or less in overall length. It is practically universal in application. Built primarily to match the actual requirements of sewing machine operators, this engineered unit is also suitable for many other uses, particularly where a small reflector is desirable. Several models are now available. Hundreds of installations have already proved their outstanding efficiency and utility.

★ Complete information on this specialized Localite unit and other units for every localized lighting need will be supplied promptly on request.

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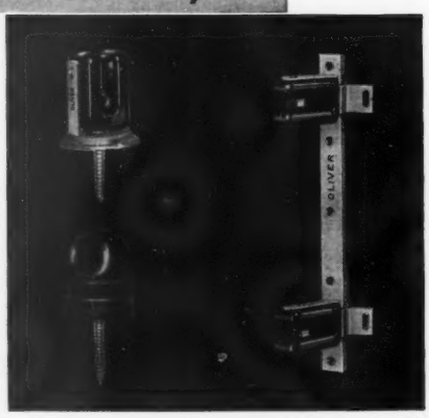
POLE LINE MATERIAL

A good specification - always!

OLIVER ALL PORCELAIN HOUSE BRACKETS . . . A TYPE AND SIZE FOR EVERY REQUIREMENT

Oliver House Brackets are made of the highest grade dry porcelain with screws, toggle bolts or carriage bolts securely cemented into insulator. Well rounded surfaces prevent chipping and assure quick drainage of water in any position.



OLIVER IRON AND STEEL CORPORATION
PITTSBURGH, PENNSYLVANIA

OLIVER POLE LINE MATERIALS
APPROVED AND ACCEPTED SINCE 1894
OLIVER

be authorized without plans and specifications. The referendum voted upon was ordered by the city commission after an appellate court decision held invalid the $1,400,000 bond issue on the ground it was based only on a preliminary plan. The bond issue was voted upon favorably by voters two years ago. A federal loan and grant of $1,515,000 for the proposed plant has been held up during litigation over the bond issue.

GALLATIN, TENN.—Voters by a vote of 568 to 34 approved on August 24 a bond issue for the construction or purchase of a municipal electrical distribution plant. The city is served at present by Kentucky-Tennessee Light & Power Company.

PORTSMOUTH, VA.—City council in a surprise move at its meeting August 24 voted to let the citizens go to the polls to decide whether or not they favor a municipal power plant. This action will bring the special balloting in as part of the November election. A resolution calling the special election was adopted unanimously, having been recommended by City Manager Charles Harper and City Attorney R. C. Barclay. The election will decide whether to repeal or make effective an ordinance enacted by the council last May to put into effect a contract with the Virginia Electric & Power Company for a low rate for electric power used by the city government, designed to effect a saving of $20,000 a year. Copies of the contract will be sent to 7,000 voters so they will have an opportunity to study it before November 2. Action of the council followed refusal of Judge White in City circuit court to grant a petition by J. P. Cherry that the ordinance be set aside.

SUPERIOR, WIS.—Wisconsin Public Service Commission has fixed $4,625,000 as the price at which the city may purchase the electric, gas and water property of the Superior Water, Light & Power Company. Citizens voted more than three years ago to acquire the utility property.

BOSSIER CITY, LA.—Acting on the statement of R. M. Winsborough, commercial manager of the Southwestern Gas & Electric Company "that Shreveport and Bossier City have the lowest residential power rate in the entire state of Louisiana" town council deferred action on a proposal to erect a municipally-owned and operated power plant.

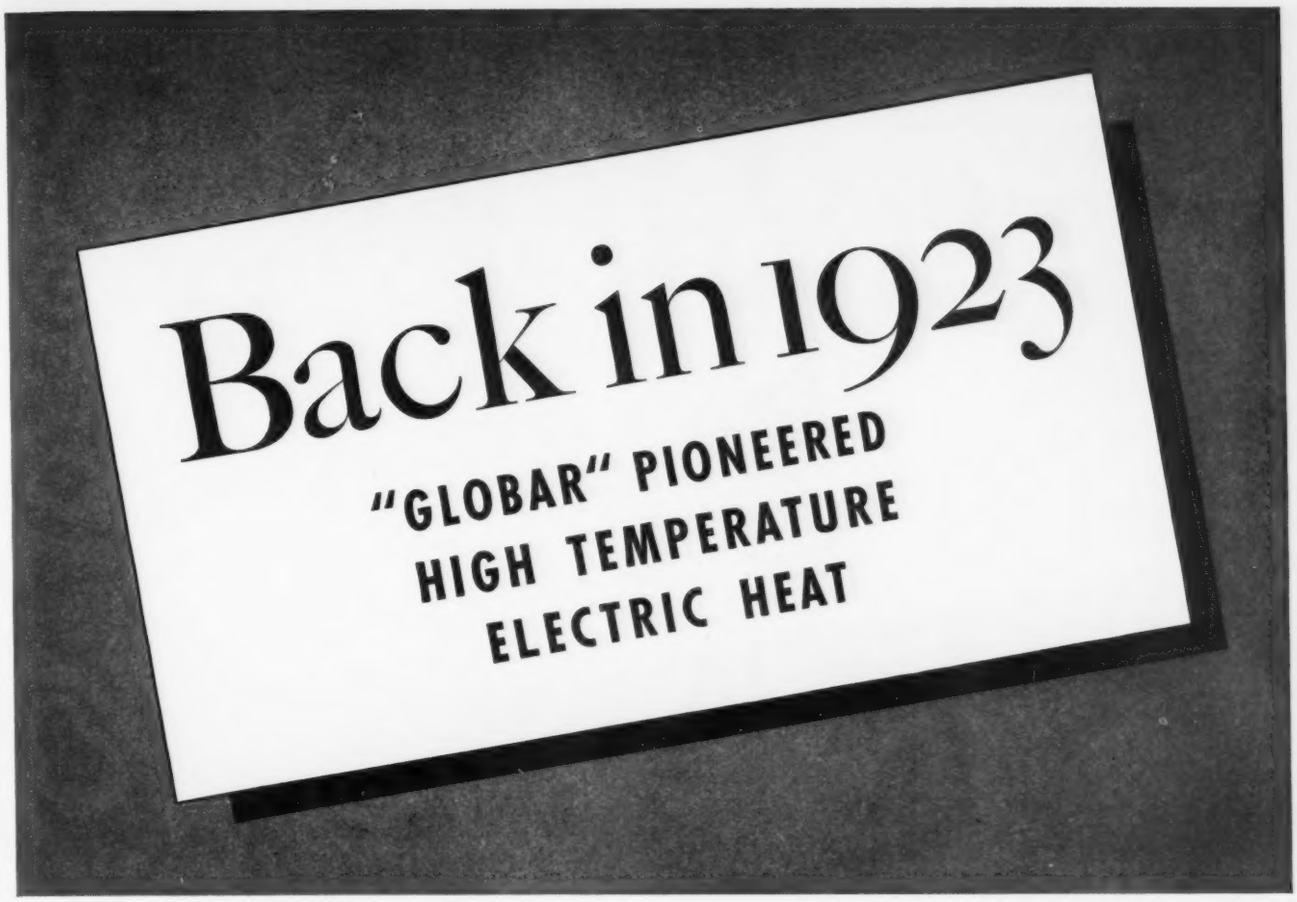
•

Wisconsin Utilities Speed Rural Electric Line Work

Wisconsin privately and municipally owned electric utilities electrified 6,336 rural premises in the first six months this year, as compared with 6,072 for all of 1936, according to the Public Service Commission.

The survey showed that the average cost of farm electric lines constructed last year by Wisconsin utilities was lower than the national average for REA-financed lines and lower than national average for utility building.

As of June 30 there were 54,198 rural premises receiving central station service, of which 47,500 were farms and the remainder rural business establishments.



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• High temperature electric heat is nothing new to "Globar" users. They've had it ever since 1923. Thousands of furnaces have proved the value of non-metallic, electric elements for high temperatures.

Long experience in the high temperature heating field has made "Globar" the leader. Thousands of installations have proved the success of Globar Brand Non-Metallic High Temperature Electric Heating Elements.

Let Globar engineers and technicians help solve your heating problems. A representative will be glad to give you more specific information. Write, phone or wire our nearest office.

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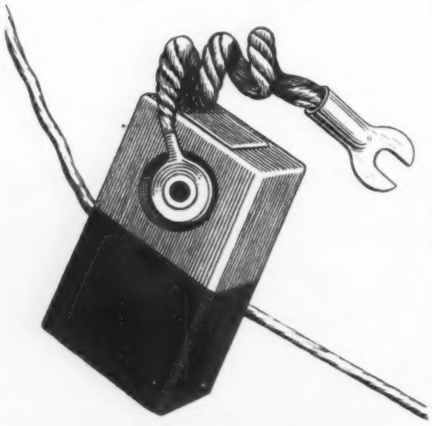
For many a manufacturer whose products incorporate braided or stranded cables of exceptional flexibility, Camden Wire Co. is his dependable source of supply. The reason for this preference can be attributed to *experience*. We have been making just one thing—bare wire—for a long time and can turn out exactly what our customers want at a price that is in keeping with production economies. Let us know your requirements. We will gladly send samples and quotations.

BRAIDED COPPER CABLES
400 to 300,000 C.M.

STRANDED COPPER CABLES
221 to 500,000 C.M.

HOT BATH TINNING,
LEADING or CADMIUM



CAMDEN
WIRE COMPANY
CAMDEN • NEW YORK

New Allotments Made by REA in August

Among the new allotments made by the Rural Electrification Administration in August were the following:

ARKANSAS—Farmers Electric Cooperative Corporation, additional $100,000. Total of $289,000 now available, 230 miles of line, 700 customers, Jackson, Woodruff and Independence counties. Wholesale power may be supplied by Arkansas Power & Light Company. Southwest Electric Cooperative Association, partial allotment $150,000, total $745,000 requested, 672 miles of line, 2,098 customers, Miller, Howard, Lafayette, Columbia, Hempstead and Nevada counties. Wholesale power may be supplied by Arkansas Power & Light. Co-operative organization to be formed in Miller County, Garland, partial allotment $150,000, $745,000 requested, 672 miles of line, 2,000 customers, Miller, Howard, Lafayette, Columbia, Hempstead and Nevada counties. Wholesale power may be secured from Arkansas Power & Light. Cooperative organization to be formed in Craighead County, $200,000, requested $400,000, 385 miles of line, 1,224 customers, Craighead, Greene and Poinsett counties. Wholesale power negotiations under way with Arkansas Power Company.

GEORGIA—Toombs County Rural Electric Association, additional $100,000 bringing total to $206,000, requested $320,000, 315 miles of line, 1,315 customers, Laurens, Treutlen, Wheeler, Johnson, Montgomery, Emanuel, Telfair, Toombs counties. Power will be supplied by Georgia Power Co.

KANSAS—Brown-Atchison Electric Co-operative Association, additional allotment, $125,000, making total of $225,000, requested $355,000, 340 miles of line, 925 customers, Brown, Atchison and Nemaha counties. Wholesale power may be supplied by Horton municipal plant. D. S. & O. Rural Electric Co-operative Association, Solomon, additional allotment, $150,000, making total of $404,651 now available, 383 miles of line, 1,100 customers, Dickinson, Saline, Ottawa, Clay, Geary, Marion, Morris and McPherson counties. Wholesale power will be supplied by Kansas Power & Light Company. Co-operative to be formed in Shawnee County, partial allotment $200,000, requested $395,000, 370 miles of line, 985 customers, Shawnee, Jackson, Douglas, Wabaunsee, and Osage counties. Wholesale power may be supplied by Kansas Power & Light.

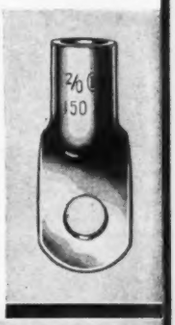
KENTUCKY—Inter-County Rural Electric Co-operative, additional $150,000, making total of $250,000 now available, 250 miles of line, 800 customers, Boyle, Garrard, Marion, Mercer, Lincoln and Washington counties. Wholesale power may be supplied by Kentucky Utilities Company. Union County Rural Electric Co-operative Corporation, additional allotment $155,000, making total of $255,000, 249 miles of line, 740 customers, Union County. Wholesale power may be supplied by Kentucky Utilities Company.

MICHIGAN—Alger-Delta Electric Co-operative, $123,000, 113 miles of line, 472 customers, Alger and Delta counties. Source of power not yet determined. Tri-County Electric Co-operative, additional allotment, $200,000, making total of $600,000 now available, requested $1,525,000, 1,386 miles of line, 4,225 customers, Ingham Ionia, Eaton, Calhoun, Branch, Kalamazoo, St. Joseph, Jackson and Berry counties.

Preferred
by leading Utilities and "Industrials"

The most careful buyers in the country use PENN-UNION conductor fittings, because of their *reliability*.

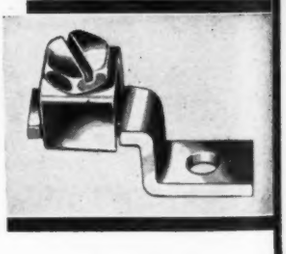
Every PENN-UNION fitting is correctly designed, and carefully tested. Every one is *dependable* mechanically and electrically.



More than 6,200 items—

For tube, bar, cable, or wire—and all combinations.

Write for the PENN-UNION catalog.



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You'll find it in the *complete* line—

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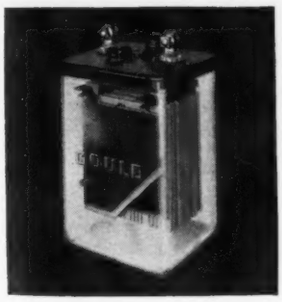
Conductor Fittings

GOULD GIVES LAZY FISH FREE RIDE!

● *Electric elevators will raise lazy salmon and steelhead who do not want to climb Bonneville Dam's fish "ladders". These elevators, like the breakers, relays, indicators, etc., necessary for the 600,000 horsepower Bonneville Dam, will be operated by Gould Batteries.*



A GOULD BATTERY FOR EVERY UTILITY APPLICATION

Gould's installation at the new Bonneville Dam will be 120 cells of OPE-517. These batteries are of the Planté type construction, available in capacities from 8 to 800 ampere hours. Write for free bulletin.

GOULD BATTERIES *for every service*

New Bonneville Dam served by GOULD batteries

Controlling the 600,000 horsepower generated at the new Bonneville Dam will be a real job! It will take batteries with plenty of punch to trip the breakers, operate relays and furnish standby power. To provide plenty of quick, reliable energy for this $42,000,000 installation, Uncle Sam has selected Gould Batteries. Sixty-nine major utilities and hundreds of small plants all over the country feel the same way about Gould Batteries. There are three types of lead acid storage battery construction for utility applications. They are the Planté, the Armored Kathanode, and the Dreadnaught. Why not investigate what Gould can do for you? Our engineers will be glad to study your problems and specify the correct battery for your particular needs. Write, wire or phone for detailed information.

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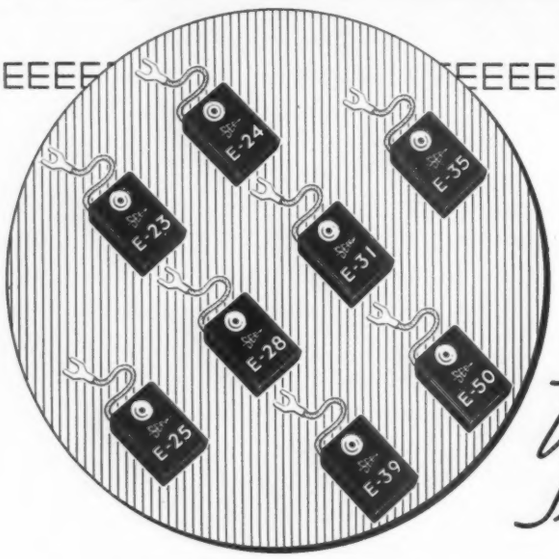
Muncie, - - Indiana



Within this Simple circle

is the end of the search for motor and generator brushes that will produce the best results on eighty out of every hundred machines now in service or going into service. These eight grades of Speer Series E electro graphitic brushes are the perfected result of more than a generation of research and development in Speer laboratories and plants, in the field and in the plants of customers.

Choose the right "E" grade for your machines and see the improvement over brushes you now think satisfactory. Speer Brush Data Sheets will indicate the right type. Write for a set, stating how many machines you wish to investigate.

SPEER CARBON COMPANY, ST. MARYS, PA.

SCC

7417

MISSOURI—Co-operative to be formed in Pemiscot County, partial allotment $175,000, requested $411,000, 429 miles of line, 1,538 customers in Pemiscot and Dunklin counties. Source of power not yet determined.

MONTANA—Co-operative to be formed in Flathead County, partial allotment, $144,000, requested $244,000, 225 miles of line, 683 customers, Flathead County. Wholesale power may be supplied by Mountain States Power Company.

NEBRASKA—Cedar County Rural Public Power District, partial allotment, $200,000, requested $472,000, 464 miles of line, 1,137 customers, Cedar and Knox counties. Power will eventually be purchased from the Loup River Public Power District. Lancaster County Rural Public Power District, partial allotment $150,000, requested $307,000, 279 miles of line, 680 customers, Lancaster, Sanders, Cass and Otoe counties. Power will be supplied by Iowa-Nebraska Light & Power Company, pending completion of generating facilities of Loup River Public Power District. Norris Rural Public Power District, partial allotment $150,000, requested $322,000, 291.5 miles of line, 726 customers, Saline and Jefferson counties. Cuming County Rural Public Power District, partial allotment $250,000, requested $450,000, 401 miles of line, 1,045 customers, Cuming, Stanton, Wayne, Dodge and Thurston counties.

OKLAHOMA—Kay County Electric Co-operative, additional allotment $145,000, total available $445,000, 445 miles of line, 900 customers, Kay, Noble and Grant counties. Wholesale power will be supplied by Blackwell municipal plant.

VIRGINIA—Farmers Rural Utilities, Inc., additional allotment $100,000, 100 miles of line, 350 customers, Caroline, Hanover, King & Queen, Louisa, Orange and Spotsylvania counties. Previous allotment, $366,800. First section virtually completed and lines are energized by Virginia Electric & Power Co.

WISCONSIN—Co-operative to be formed in Lafayette County, allotment $157,000, 147 miles of line, 448 customers in Lafayette County. Power will be supplied by generating plant near Chippewa Falls for which REA has allotted $650,000. Co-operative to be formed in Grant County, partial allotment $200,000, requested $490,000, 442 miles of line, 1,391 customers, Grant County. Wholesale power will be supplied by generating plant near Chippewa Falls. Wisconsin Power Co-operative, additional allotment $500,000, making total of $650,000, requested $900,000. It is expected $450,000 will be used to build generating plant to serve REA-financed projects and $450,000 for transmission lines.

MINNESOTA—People's Co-operative Association, Inc., additional allotment $118,000, making total of $173,000, 164 miles of line, 400 customers, Olmstead County. Co-operative organization to be formed in Stearns County, partial allotment $150,000, requested $493,000; 475 miles of line, 1,081 customers, Stearns, Pope, Todd and Morrison counties. Carver County Co-operative Electric Association, partial allotment $100,000, requested $152,000, 143 miles of line, 477 customers, Carver, Sibley and Hennepin counties.

TENNESSEE—Tri-County Electric Membership Corporation, additional allotment $115,000, 105 miles of line, 487 customers, Allen, Barren and Monroe counties, Ky. Although headquarters of the project are in Lafayette, Tenn., all the lines for which this allotment was made are in Kentucky. Wholesale power may be supplied by Tennessee Electric Power Company.

NONE CAN EQUAL KLEINS

The Klein trade-mark is familiar to electricians, linemen, safety engineers, good workmen everywhere. It is a guarantee of maximum quality and maximum satisfaction.

The popular "streamlined" side cutting plier. The Klein line includes pliers for every use — long nose, oblique cutting, flat nose, etc. Send for the Klein catalog and lineman's handbook containing information of value to all electricians.

The honest quality that makes Kleins preferred by electricians and linemen today is the same quality that has been responsible for Klein leadership, "since 1857." Kleins are made from a special alloy tool steel, drop forged and oil tempered. The knives are carefully honed by hand to insure a lasting, sharp cutting edge. Each plier is individually adjusted and individually inspected and tested. The knives must match—the handles must have the proper spring for a tireless grip, and each plier must prove its ability to cut wire easily and to stand up under service far greater than it will ever receive in use. Over years of service no plier is as economical as Kleins. For safety, for ease in use, for genuine, all around satisfaction, master workmen prefer Kleins.

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Foreign Distributor: International Standard Electric Corp., New York

Mathias Klein & Sons
Established 1857 — Chicago, Ill. U.S.A.
3200 BELMONT AVENUE

Klein leather goods are made from the first quality "slow process" vegetable tanned harness leather, selected for its strength and durability and checked by chemical analysis and frequent laboratory tensile tests. All "D" Rings, snaps and buckles are drop forged from bar steel. Riveting is done by hand with solid copper rivets. Standard of quality with utility companies, railroads and linemen everywhere.

The new "Klein-Kord" fabric safety strap takes a load of 2,400 lbs. before ripping at the tongue. Of uniform strength and thickness throughout, it will not stretch. Assures long wear and a full factor of safety. Ideal for tower work. Adopted as standard by many public utilities.

Klein Climbers are made in standard weights and sizes, as well as in a "light weight" type for those who prefer. Shanks and gaffs are individually tested to insure perfect riveting and temper. The leg iron is of spring steel. The spur is forged from tool steel. Designed for comfort. Ask the man on the pole. The odds are his climbers are Kleins.

The new Klein improved "Chicago" Grip for electrical conductors or guy work. A universal grip that will take messenger or guy strand from 3/16 in. diameter up to 1/2 in. diameter. May also be used satisfactorily on bare conductors, solid or stranded, from No. 6 to No. 4/0 seven strand copper. Also ideal for A.C.S.R. up to No. 3/0. Bronze-lined jaws prevent slipping and increased leverage assures a sure grip under all conditions with loads up to 8,000 lbs.

Klein Splicing Clamps are made in a wide variety of sizes and styles to fit every purpose. The combination wire and sleeve clamps may be used for twisting bare wire and sleeves. Special styles are carried for telephone and telegraph linemen and power companies, each designed for the sizes most used in its particular field.

Why Not Bend Conduit This Way?

You Will Find It Faster . . . Better and Cheaper!

If everyone knew about the advantages of bending with the Greenlee Hydraulic Conduit and Pipe Bender, there wouldn't be much time wasted with old-fashioned, back-breaking methods. And there would be more conduit installed where the bends are smooth and even, not to mention the time that would be saved in making them.

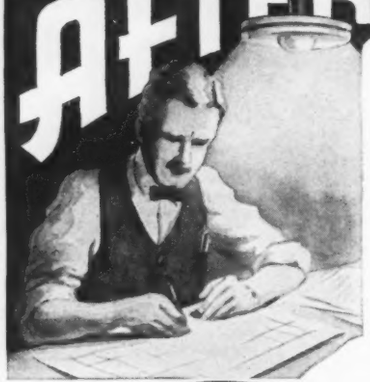
Here is a portable tool that is simple and easy to operate, yet it bends conduit quickly, making smooth even bends on any size within its range. Hydraulic pressure, set up by pumping the handle, does the bending. And its operation is just as simple as the picture indicates.

Above is the Greenlee Rigid Conduit Bender in use. It is made in two sizes for conduit from 1¼ to 3-inch and from 2¼ to 4½-inch. The small bender can be fitted with special attachments for bending thin-wall steel conduit in 1¼, 1½ and 2-inch sizes.

Complete information on Greenlee Conduit and Pipe Benders will be sent gladly. Tell us what you want to bend.

GREENLEE TOOL CO., 1705 Columbia Ave., ROCKFORD, ILL.

AFTER HOURS



After the rest of the force is gone, it is economy to burn only enough light for those still working. This means individual control of lights. And this means McGILL Levolier Switches. That is, if easy, positive operation and unusually long, trouble-free service are factors. Every Levolier Switch is made as carefully and accurately as a watch — and of finest materials. And every one is individually tested under full load before leaving the factory. Your wholesaler can supply you from stock.

A complete line, 3 to 10 amps. to meet every need in canopies, fixtures, conduit boxes. Also special switches and models for fractional h.p. motors.

McGILL *Levolier* SWITCHES

McGILL MANUFACTURING CO.
VALPARAISO, INDIANA
Box No. 601

Sales Opportunities

HASTINGS, NEB.—Central Nebraska Public Power & Irrigation District, Hastings, has plans maturing for two hydroelectric generating plants in Jeffrey Canyon and Johnson Canyon, respectively, with transmission line between two plants for inter-connecting service, and other transmission lines for connection with existing high-tension system, including power substation and switching stations. Fund of $20,096,000 has been secured through Federal aid for project, a portion of appropriation to be used for completion of Keystone Dam and hydroelectric generating station. George E. Johnson is chief engineer and general manager. Work is scheduled to begin this fall.

NICHOLASVILLE, KY.—Bluegrass Rural Electric Co-operative Corporation, Nicholasville, Philip R. Holloway, superintendent, is completing plans for primary and secondary lines for rural electrification in parts of Fayette, Madison and Jessamine Counties, totaling about 225 miles, with outdoor power substation and service facilities. Initial work will comprise about 120 miles, for which financing in amount of $120,000 has been secured through Federal aid. Additional financing for remainder of project will be arranged later.

MOUNT CLEMENS, MICH.—Chrysler Corporation, 341 Massachusetts Avenue, Detroit, Mich., plans installation of motors and controls, regulators, power substation equipment, conveyors, electric hoists and other equipment in new branch automobile plant near Mount Clemens, where tract of about 45 acres of land has been acquired, to consist of several one and multi-story units. A power house will be built. Entire project will cost about $2,000,000.

WASHINGTON, D. C.—Commanding Officer, Washington Quartermaster Depot, receives bids until September 20 for 24 gasoline engine-driven electric generator sets for Camp Custer, Mich., and Fort Leavenworth, Kan., respectively (Circular 24).

TUSCUMBIA, ALA.—Electro Metallurgical Company, 30 East Forty-second Street, New York, N. Y., plans construction of large electric furnace works on tract of land in Colbert County, vicinity of Tuscumbia, comprising several operating units. A power substation will be built for connection with transmission lines of TVA, which has contracted to furnish power up to a demand load of 40,000-kw., from Wilson Dam hydroelectric power plant. Other electrical equipment, including motors and controls, will be installed for plant service. Entire project is reported to cost over $600,000. Company is a subsidiary of Union Carbide & Carbon Corporation, first noted address.

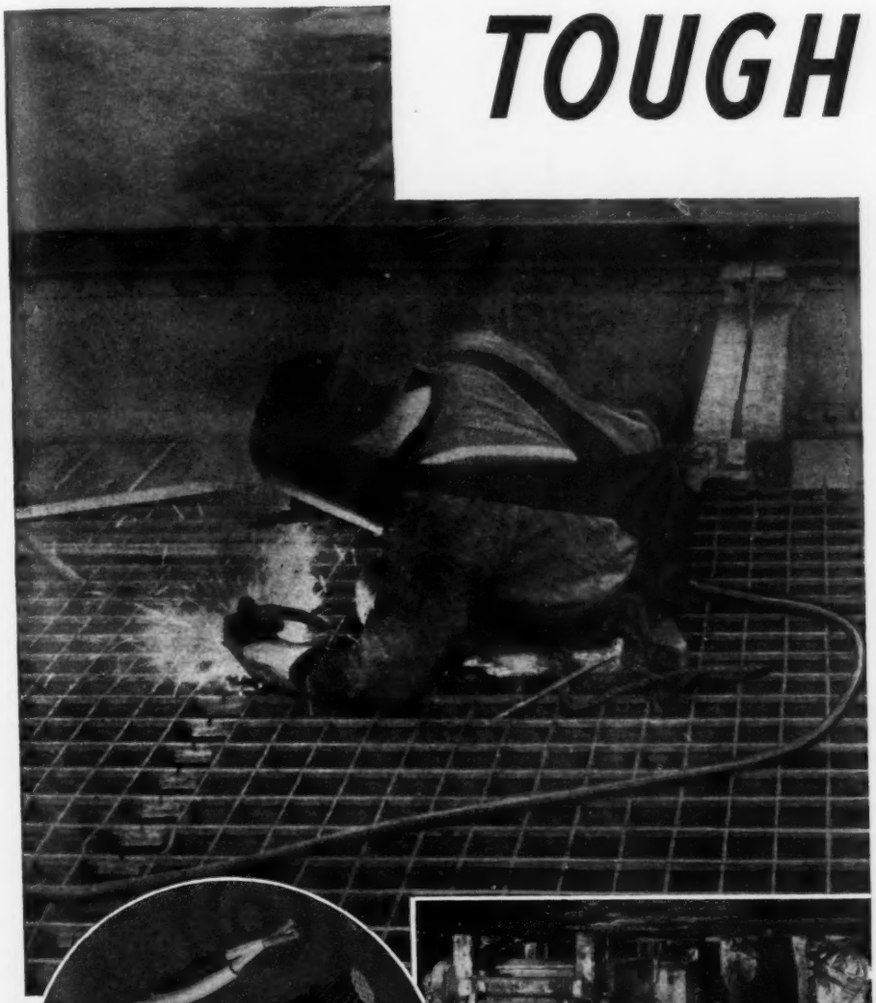
MADELIA, MINN.—Receives bids until September 28 for equipment for new municipal electric power plant, including diesel engine-generator units and complete auxiliary equipment. Also, at same time, for electrical distribution system. Burlingame, Hitchcock & Estabrook, Sexton Building, Minneapolis, Minn., are consulting engineers.

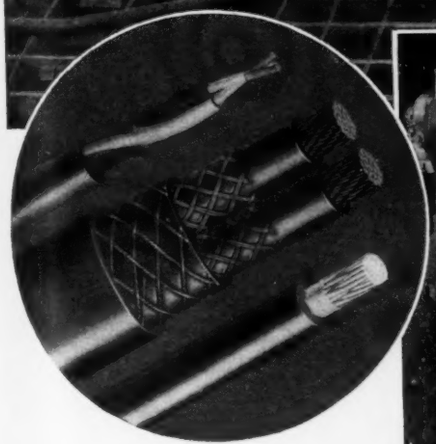
ROCKWALL, TEX.—Rockwall County Co-operative Electric Company, Rockwall, has plans maturing and will take bids soon for primary and secondary lines for rural electrification in parts of Rockwall, Hunt and Colling Counties, approximating 200 miles, with outdoor power substations and service facilities. Fund of $200,000 has been arranged through Federal aid. William G. Morrison, Professional Building, Waco, Tex., is consulting engineer.

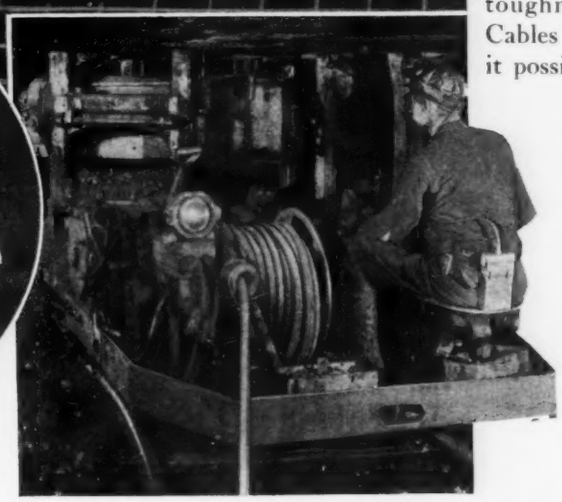
CHICAGO, ILL.—Ceco Steel Products Com-

TOUGH *they have to be . . . and*

TOUGH *they are!*







IF YOU use electrical Cords and Cables you will find it worth your while to investigate Amerclad All-Rubber Cords and Cables. For whatever your requirements may be you will find that they are within the Amerclad range. You will find, too, that Amerclad All-Rubber Cords and Cables will always meet your electrical needs with complete satisfaction and economy.

Amerclad construction consists of one or more conductors encased in a protective sheath of tough, resilient rubber. It is this tough protective covering that gives added life to Amerclad Cords and Cables. It resists rough treatment, oil, water, and abrasive wear . . . it withstands the rigors of heavy duty which are particularly destructive to portable cords and cables. Yet, with their extra toughness, Amerclad Cords and Cables have the flexibility that makes it possible to move them from place to place with ease.

Amerclad All-Rubber Cords and Cables are made by the American Steel & Wire Company, manufacturers of a complete line of Electrical Wires and Cables. When you order "Amerclad" you get the quality that is based on more than a century of wire-making experience. Send for our catalogue.

AMERCLAD *All-Rubber* CORDS AND CABLES

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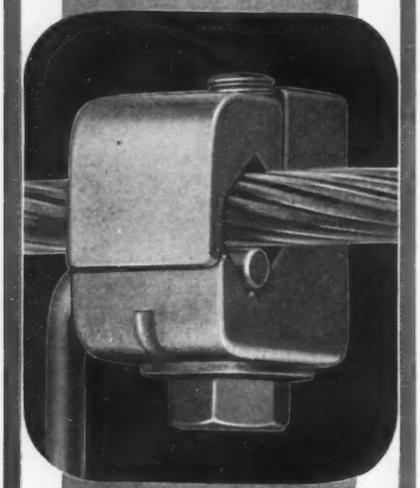
UNITED STATES STEEL

The

FARGO

UNIT CONNECTOR



Not a Complaint in a MILLION

● **Millions in use, yet not a single complaint during the past year is the record of Fargo Unit Connectors.**

The Fargo one-piece design has no parts to lose, is always threaded. It insures high compression at low wrench torque. Joints are high in conductivity, low in voltage drop. Jaws are vibration-proof. Built of high strength, distortion-proof copper alloy, Fargo Connectors stand repeated use.

Write to Line Material Co., South Milwaukee, Wisconsin, for full details.

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Fargo Manufacturing Co.

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LINE MATERIAL CO.

pany, 1926 South 52d Avenue, plans installation of motors and controls, regulators, transformers and accessories, conveyors, electric hoists and other equipment in new local mill at Fifty-eighth Avenue an West 26th Street, where tract of about 20 acres has been secured. Cost over $500,000.

SACRAMENTO, CALIF.—Constructing Quartermaster, United States Army, Sacramento, receives bids until September 15 for an electrical distributing system and street-lighting system, as per plans and specifications on file. Appropriation of $80,000 is available.

CALEXICO, CALIF.—Board of Directors, Imperial Irrigation District, El Centro, receives bids until September 21 for equipment for hydroelectric generating plant at Drop 4, All-American Canal, vicinity of Calexico, including one vertical shaft 13,300-hp., hydraulic turbine with complete accessories, one 12,000-kva., vertical shaft, a.c., electric generator and auxiliaries, and for one governor with pumping equipment for regulating speed of prime mover noted, all all as per plans and specifications on file. M. J. Dowd is chief engineer.

DWIGHT, NEB.—Iowa-Nebraska Light & Power Company, Lincoln, Neb., plans extensions in transmission line from Dwight to Brainard, Neb., about 10 miles. Application has been made for permission.

WATERVLIET, N. Y.—Ludlum Steel Company, Watervliet, plans installation of heavy-duty motors and controls, regulators, conveyors, electric hoists and other equipment in connection with expansion and improvements in plant, including several new units for large increased output. Entire project will cost about $1,400,000. Financing is being arranged.

PEABODY, MASS.—Plans early rebuilding of portion of municipal electric power station on Endicott Street, recently damaged by fire. Loss reported close to $30,000, including equipment.

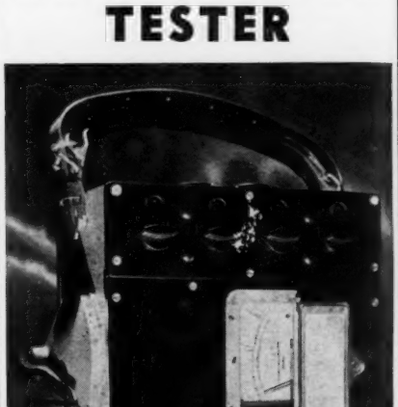
LUMBERPORT, W. VA.—Harrison County Rural Electrification Association, Lumberport, E. V. Richardson, chairman, is having plans completed by Louis T. Klauder, Lincoln-Liberty Building, Philadelphia, Pa., consulting engineer, for steam-electric generating plant for power supply for rural electrification system, recently noted in these columns. Proposed to begin work soon. Fund of $100,000 has been arranged for plant through Federal aid.

SAULT STE. MARIE, ONT.—Great Lakes Power Company, Ltd., Sault Ste. Marie, will begin work in thirty to sixty days on new 10,000-hp. electric power plant, near mouth of Montreal River. Cost close to $1,000,000.

LAMAR, COLO. — Edward O. Russell, Lamar, is at the head of new electric cooperative association, now being organized (name to be selected soon), to construct and operate a rural electrification system in parts of Bent and Prowers Counties, totaling about 165 miles of primary and secondary lines, with outdoor power substations and service facilities. Financing in amount of $175,000 is being concluded through federal aid. Work is scheduled to begin at early date.

CLEVELAND, OHIO—Marquette Metal Products Company, 1145 Galewood Drive, plans installation of motors and controls, conveyors, electric hoists and other equipment in connection with expansion and improvements in plant. Cost about $200,000.

"BRIDGE-MEG" RESISTANCE TESTER



A complete resistance measuring instrument

The "Bridge-Meg" is a combined "Megger" tester and Wheatstone Bridge for measuring conductor resistance in ohms by the Bridge method, and for testing insulation resistance in ohms or megohms by the "Megger" method.

Ranges—From .01 Ohm Up to 200 Megohms.

The instrument is exceedingly simple to use, including a rotary switch to change instantly from one function to another.

A "Megger" instrument in every sense of the word, the "Bridge-Meg" is unique as an all-round resistance testing set for utility, industrial, railway and other engineers who need to measure all kinds of resistance quickly and easily. It is self-contained with constant-pressure hand generator rated up to 1000 volts d.c.; weighs less than 13 lbs.; is rugged, portable, ready for instant use anywhere and for almost any resistance test.

Let us tell you more about this wide range "Megger" instrument and its companion—the Varley Loop "Bridge-Meg" (arranged to make Varley loop tests for locating faults in conductors).

Ask for Catalog 1400-W

JAMES G. BIDDLE CO.

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Insulation Testers - Ground Testers - Ohmmeters - Tachometers - Frequency Meters - Laboratory Rheostats - Scientific Apparatus - High Vacuum Equipment